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2

3

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5

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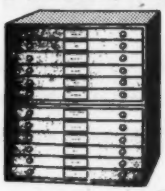

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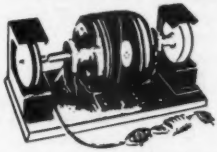

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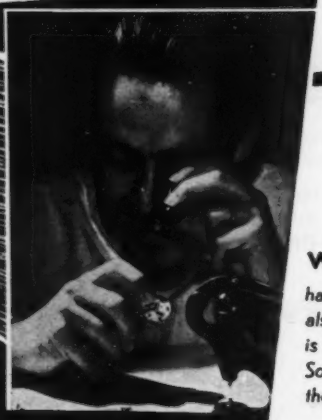

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Orville R. Hagans.

The latest in scientific accomplishment for horological progress features a mechanical rather than chemical way of preventing oil loss.

Preserving the Fluidity of Oils in Watch Movements

A special report by Henry B. Fried

GREAT STRIDES have been made as a result of horological research. Some of these have been in the field of metallurgy, escapement design, hairsprings and in balance units. As a result, even wrist watches have been produced which have won observatory awards for accuracy. However, the ability of these watches and mass-produced timepieces to maintain their rates over a long period has not kept pace with the general advance of horological progress and scientific accomplishments.

The inability of the oil to remain fluid is one of the chief reasons for this deficiency. True, intense research is continuing in the field of horological lubricating elements and oils are constantly showing improvement. So far, these advances have not been as startling or as dramatic as those in metallurgy (balances, hairsprings, mainsprings) or in winding, shockproofing and waterproofing devices.

A recent patent granted to Rene A. Fichter acknowledges a unique but logical approach to this problem. Instead of delving into the chemical approach to the oil problem, the approach here is mechanical and aims to preserve the available oils applied to the watch jewels so that it remains uncontaminated and fluid for longer periods than is expected in the present method of application.

In a lecture before the Horological Society of New York last December, Mr. Fichter, a member of the horological family producing the "Rayville" watch, and a graduate engineer of the St. Imier school, listed the main causes for oil failure. These were: a, evaporation; b, contamination; c, displacement. Mr. Fichter said that evaporation generally takes place more rapidly in warmer and drier climates than in colder or damper areas. The presence of air currents also hastens the evaporation as well as acting as a carrier of foreign particles to the oil wells in the watch bearings where it mixes with the oil and diminishes the oil's effectiveness and life.

Displacement occurs through faults in the structure of the oil and in its tendency to spread. Many oils are marketed today which are constructed to remain "put," thus narrowing the over-all problem. However, shocks and sudden jars will also disperse the oil from its applied spot.

The solution to this problem, Mr. Fichter reasoned, could then be facilitated by providing a mechanical means (if not chemical) of preventing evaporation and contamination by eliminating all the listed

causes of these faults. In examining hundreds of watches coming in for repairs, especial emphasis was placed on examining the oil content. It was found that while practically all the upper train jewels were dry or gummed, those on the main plate and those that were capped still had oil and were clean.

It was then reasoned that the upper jewels were exposed, while those below had the protection of the dial. Also, the upper train plate was close to the case back when worn on the wrist, and thus warmer, was subject to more rapid evaporation and deterioration. While some oils do perform well and claim a certain degree of stability at moderate temperatures, the convection currents caused by heat are a contributing factor toward evaporation.

Figure 1 shows a cut-away view of a wrist watch as it is worn. The room temperature is 72° F. The case back next to the wrist is 92° F. Between the crystal and the movement it is 89° F. On the outside of the crystal it is 81° F. From the bottom of the case to the top of the watch there is a change of over 10° F. in about 5/16ths of an inch. This is sufficient to set up convection currents within the watch which supply the evaporating draft or element as well as the movement of microscopic particles attacking the oil.

Cap jewels are a partial answer to this problem. The incidental capillarity of pivot-end and jewel with its oil supply as well as with the hole jewel provide for more oil than can be contained in the open-end jewel and pivot. Also, it prevents the contamination of oil with dust and lint. Convection currents cannot find a thoroughfare to aid in the evaporating process. However, cap jewels which act as end-thrusts to the pivots when employed in the train are expensive attachments and do not provide the same authentic bearing surface as, say, a cap jewel in a railroad watch with considerably heavier wheels and pinions. Cap jewels as end-thrusts bearings in wrist watches where the side thrust overcomes any tendency of the wheel to drop on a cap jewel as in a large railroad watch, serve a negligible mechanical purpose. This, Mr. Fichter added, also requires especially shaped pivots and carefully placed jewels and finely adjusted endshakes.

In the patent called "Resevoil," the claims are that one plate covers *all* the upper train jewels, including the center and these not necessarily acting as end-thrusts in the traditional sense. *Figure 2* shows the general scheme. The lower illustration shows a regular watch movement, fully hole-jeweled. An auxiliary plate shown above is fitted over the train plate by removing the bridge screws and substituting especially supplied shoulder screws to fasten the "Resevoil" plate to the movement. In this auxiliary plate, over each hole jewel in the train bridge is

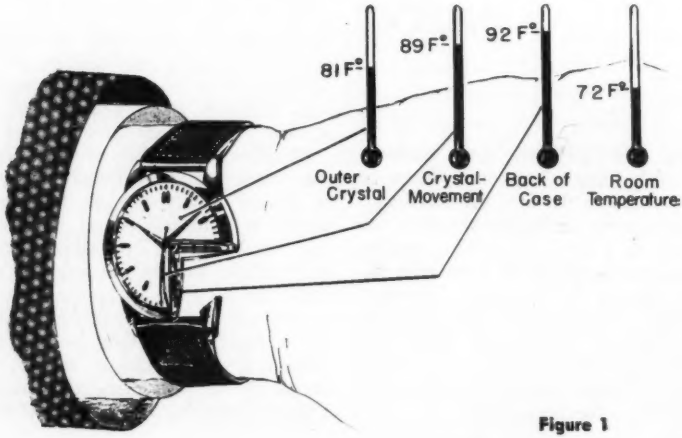

Figure 1

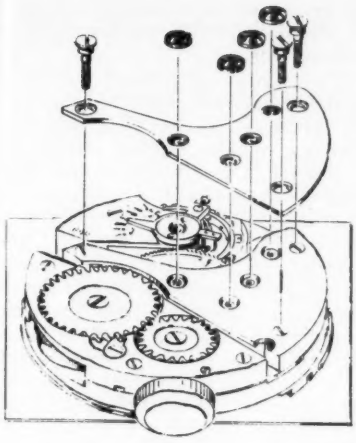

Figure 2

placed an unpierced jewel as shown in the exposed view above the special plate.

Before the plate is fastened to the bridge, oil is applied to the underside of each of the unpierced jewels to moisten or saturate the atmosphere close to the hole jewel in the contention that the oil in the jewel hole will have less tendency to dry in an oil-moist, closed area than otherwise.

Figure 3 illustrates the claims set forth in the patent (No. 2478865). *B* in both views is the upper train plate. *A* is the auxiliary ("Resevoil") plate attached to the upper bridge purposely shown in this drawing withdrawn from one jewel to

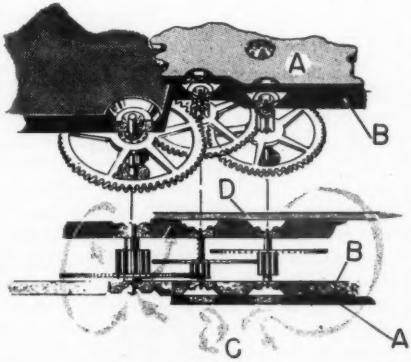

Figure 3

illustrate effects. *D* is the dial. *C* depicts the convection currents. At the uncovered jewel, these currents are free to attack and eventually flow through the jewel openings. At the covered areas over other hole jewels the convection currents are repulsed, finding other avenues of passage. Jewels are used instead of polished steel or other metals because these will not form a metallic oxide in contact with oil or its vapors. Unpierced jewels also are not expensive to produce and can be better polished to hold the oil.

Figure 4 shows a more elaborate setup covered by the patent in which it is claimed it is possible to actually create a reservoir of oil. *A* is the unpierced jewel cover, much like an ordinary cap jewel. *C* is the hole jewel bearing the arbor pivot. *B* is a loose jewel hole convexed on both sides and so designed to rest on the

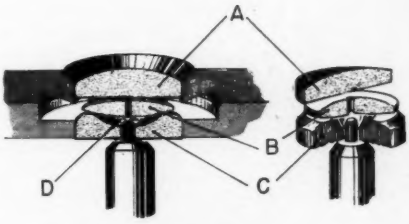

Figure 4

rim of the lower hole jewel's oil sink. Oil is applied to the hole jewel's oil sink in the usual manner. Then the loose hole jewel is put in place held by the capillary action of the oil. Above this double-convex hole jewel is placed the cap *A* with its own supply of oil. All three jewels are then connected by their combined oil supply. The loose jewel, by its minute shiftings aid in keeping the huge supply of oil in agitation, which it is claimed prolongs its fluidity. Oil is fed to the pivot bearing jewel as it is needed through the capillaries. The enclosure of the whole unit in the airtight compartment shown is designed to retard evaporation.

In this lecture, Mr. Fichter quoted leading authorities on jewel bearings and their concurrence with Mr. Fichter in the ideas set forth in this patent which lists four other but similar devices of oil bearing jewel units.

Reducing Comebacks To a Minimum

Lecture Five—

Adjusting a Railroad Watch

By Dr. H. Atlantis Sudbury

■ WHAT IS CONSIDERED good timekeeping by the public today? One young man expected his watch to keep perfect time because the word "precision" was on the dial. Another complained because his watch gained seven seconds in one week. He said that a friend had a cheaper watch than his, and it kept perfect time. In this case, the repairman made the awful mistake of moving the regulator to please the customer.

Of course these are extreme cases, but in these days of catching airplanes, trains, busses and making appointments, the average man expects his watch to keep within reasonable limits of seconds a day, which is often closer than the factory guarantees. This throws a much heavier load on the watch repairman than he realizes.

Constant complaint from the public is not helping our situation, and it is provoking newspaper and magazine writers to print articles on time, watches, watch repairing and cheating jewelers. In the *Consumer's Research Bulletin* for November, 1953, we read, "It is better to let a watch go without cleaning as long as possible if there is doubt about the competence of the watch repairman, for much harm is done to good watches by poor workmen." This article covers five large pages, and is well written by someone who has made a thorough investigation of what is being done in selling and repairing watches. Owners of valuable timepieces are always willing to pay the right price for good work.

The majority of railroad watches that we checked last year were far below standard railroad requirements, so let us consider one of these watches and see what is required to put it into as near perfect timekeeping condition as possible. We would suggest that you who read these lectures take an old 16-size watch, 15 jewels or better, and put it in perfect condition —even if you work on it only fifteen minutes a day. Remember, our main object is to give you the easiest, quickest and best way to attain perfection as a watch repairman. But all our work will be in vain if you fail to put into practice what you have learned.

Always remove any magnetism from the watch first, and from the tools you intend to use. Magnetized tools rob much of our time. Before removing the hairspring, note if it is cupped up or down, and remember that when you are working on the overcoil. The best way to remove the hairspring is to lift it off by inserting a small square point into the slot and with a turning and lifting motion, the hairspring is raised from the staff easily. Two of these squares, made from small needles inserted into a small brass tubing or wire, for a handle, will meet all your needs. The square on the end of these needles should measure twelve by fifteen hundredths millimeters (.12 x .15) on one, and seventeen by twenty hundredths millimeters (.17 x .20) on the other.

Check Points

The condition of the balance wheel is of utmost importance. If the balance arm has been peened or a botch job has been done on the balance staff, it will be difficult if not impossible to bring the watch into close time. If the wheel is in fair condition, check the size of the balance pivots with a good jeweled gauge. Eleven hundredths of a millimeter (.11) gives the best results for a 16-size watch. Both pivots must be exactly the same size and highly burnished. Burnish the ends of the pivots as flat as possible by hand. A good, hardened steel burnisher can be purchased

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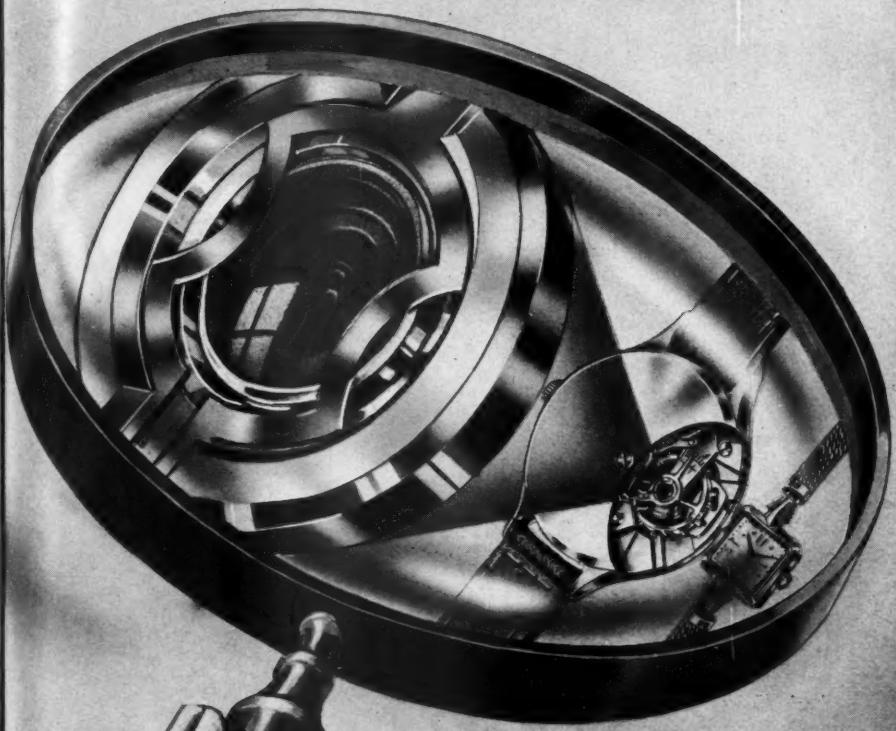

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reasonably and is a must in fine watch repairing. Stone slips do a good job of cutting and polishing before burnishing, and they do not leave particles of cutting abrasives imbedded in the pivots to enlarge the holes and drill pits in the end stones. When a workman burnishes a pivot, he actually case-hardens that part while he polishes the surface.

Measure the size of the holes in the balance jewels with a gauge for that purpose or place one on fine, round, tapered broach far enough to hold; then find the same size hole in the jeweled gauge. If it is an olive hole jewel and not over eleven and one-half hundredths millimeters (.115) it will do. It is usually necessary to put in a new staff for extremely fine rating. Select one with an 11-size pivot and test the size of the jewel hole by standing the staff upright in the jewel. If it tips five degrees (5°) to either side of perpendicular, you have a perfect fit. If the pivots fit snugly in their respective jewels, polish down the pivots to a perfect fit, being careful not to reduce the size too much, as a very small amount will do. Be sure to have both pivots and jewels alike.

Truing Procedure

Check *all* endstones and polish out all pits. This can be done easily on a well-oiled diamond lap and finished on a block if necessary. After the balance staff has been staked in and tested for firmness, and the roller table replaced, remove all old timing washers and true up the wheel perfectly in both the flat and the round. Always check a truing job the second time. It is almost impossible to have a balance wheel stay in one position on the poising tool, due to air currents, magnetic attraction or irregular or unlevel poising agates. When you think you have the wheel about perfect, rub a piece of pith along the jaws and push the pivots down into the pith and try again. If we must have a wheel that turns to one spot, let it be in line with the slot in the hairspring collet.

Place the balance wheel in the watch and screw down the bridge—we are assuming that you have dismantled the movement—test the wheel for freedom in all positions, including endshake, by letting it run after blowing on it with a blower. To save time, line up the roller jewel and note where the hairspring stud will be on the edge of the wheel.

A watch can be thrown off 45 seconds a day by just moving the center coil of the hairspring. So you see how important it is to have the spiral recede evenly away from the collet when the wheel is turned at a uniform speed. Distortion of this kind happens mostly in small watches where the hairspring collet is driven on over the wrong size shoulder. In a well formed hairspring, one of the coils near the middle will seem to stand still when the watch is running. The lateral wobble of a hairspring can easily be removed without taking the spring from the wheel.

Stand the wheel on edge so the stud will be evenly balanced on the spring; that is, not pulling the spring to one side or the other. Turn the wheel slowly around and you will see that the spring does not lie even with the rim of the wheel. A little touch in the right place to the side of the center coil will bring the spring back to its former position.

There is only one way to make a hairspring perfectly level with the bridge and at the same time bring the collet to dead center, so there will be no side pull on the balance assembly. Fasten the hairspring in the bridge, without the balance wheel, and see that the contour of the hairspring from the stud is the same as that of the

"I was hoping somebody would ask me that."

regulating pins, so when you move the regulator the collet will stay in exactly the same place. It is important to have the pins close up against the hairspring for this test. Now shape the spring so that the hole in the collet is exactly over the balance jewel. Remember that isochronism depends a great deal upon the position of the overcoil in relation to the rest of the hairspring, so do not disturb it unless you know it to be wrong.

Hairspring Finishing

Now check the hairspring in the flat and make it parallel with the bridge. Look at it from every angle. Move the regulator back and forth and see if you have disturbed that part of the hairspring. Check the position of the collet again and remove from the bridge. Someone has truthfully said that a watch repairer is no better than his hairspring work—but don't let this apparently difficult job discourage you. In reality it is very easy, once you get the knack of it. The best part of it is you will be able to regulate a watch that can be regulated. There is only one way to learn and that is by doing it yourself. Read these lectures over and over. Each day you will discover something new.

If you have a hairspring that is in bad shape and you want to straighten it, the best place to work is on a pocket size glass watch crystal. Lay the crystal flat on a surface and sand it well with sandpaper or emery cloth until it looks like ground glass. Lay the spring on this and you will be surprised. The light shining through the ground glass casts no deep shadows; the rough surface holds the hairspring while it slants toward your face and makes it very easy for you to see what you are doing.

Put the hairspring on the staff in its proper place and if all other repairs have been made, put the parts into the basket and clean the watch. It is best to make all repairs before cleaning a watch.

Next month this series will present "Materials Used In A Watch," by Norman D. Luth.

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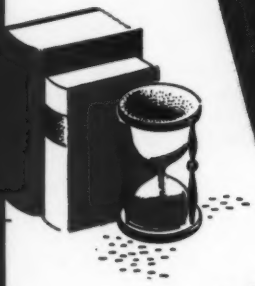

Escapement can be set up quickly and easily if only a few simple rules are observed

Adjustment rules

FSR: Will you please recommend a good book on escapements and if space permits, will you please explain how to arrange the pallets so the balance will take proper motion.

Answer: There are several good books pertaining to watch work that include a text on adjusting the escapement. A request to the editor of the American Horologist & Jeweler will bring a complete list of the latest textbooks for your information. You will find that different authors have different views on adjusting the escapement, however, with the different views and methods explained, it all sums up that the final results will be satisfactory. The following instructions for setting up the escapement is simple and effective: Before setting up the escapement, see that the balance pivots are in perfect condition, likewise balance hole jewels, side shakes close and end shake not more than .001 inch. See that the roller jewel fits the fork slot properly and that it is set upright in the roller, the face of the jewel being square to a line running through the center of the roller and that the roller jewel stands directly in the center of the crescent. (See Fig. 1, Page 24).

Examine the fork slot for scores or pit marks where the roller jewel contacts. If the fork slot shows wear, the slot must be refinished. If considerable refinishing is necessary, a new roller jewel is selected to fit the slot (See Fig. 2). These are the first steps that are carefully taken care of.

Put the balance in the watch and by means of banking screws, adjust the lever so the jewel pin will pass by the corner of the fork slot, allowing .001 inch freedom. This adjustment must be carefully made so the jewel pin has equal freedom from both corners of fork slot. (See Fig. 3). Next step is to check length of guard pin. The balance is revolved so the roller jewel is half way around. In other words, the guard pin is out of the crescent, riding the periphery of the safety roller. If the guard pin binds, it must be shortened until it is free, allowing .0005" for freedom, which must be equal on both sides of the roller. (See Fig. 4). When these conditions have been satisfied, we are ready to set the pallet stones. The stones are adjusted so there will be an equal safe

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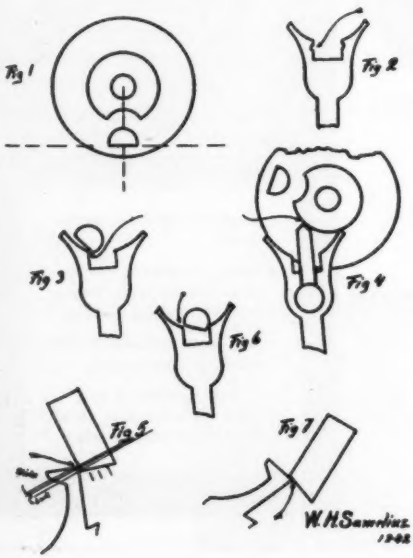
drop lock on both stones and at the same time show some slide. (Do not move the banking screws to create slide). Slide must be created by adjusting the pallet stones.

The total lock and slide should not amount to more than 1/4th width of stone for ordinary watches; on high grade watches the total lock and slide can be refined to 1/5th and in some cases, to 1/6th the width of the pallet stone. (See Fig 5). We then test the escapement, holding the movement on edge and the balance directly over the lever, then the balance should show perfect freedom.

The last and final check for the safety of the escapement is to lead the balance slowly until the escape wheel tooth drops from one stone and is arrested by the opposite stone. At that moment, test the shake of the lever and examine the escape tooth, making sure that tooth is still at rest on the locking face of the stone. This is known as the let-off test. If the tooth unlocks at this point, the escapement is not safe.

The possible remedy would be to set the pallet stones a trifle deeper or move the roller jewel forward to eliminate the lost motion or play that occurs in the escapement action at this point. (Fig. 7).



If these instructions are closely followed, no difficulty in setting up the escapement should be experienced.

Checking a losing rate

W. W.: I cleaned a gent's wrist watch about a month ago. It kept very good time for 10 days, but then began to lose considerably, anywhere from 10 to 30 seconds, and finally it stopped. Since it came back I have gone over it very carefully, checking everything I could think of, yet after putting it together again, it has lost nearly 45 minutes in less than 12 hours. What can you suggest?

Answer: The first part of your question would suggest that the watch has been put in service with a dry escapement. When oiling of the pallets is overlooked, the results are likely to be just about as you describe. May we assume that the escapement was oiled on your second careful checkup? If so, we must look for some other fault. That it loses 45 minutes in 12 hours indicates that the trouble is serious. Have you tested for magnetism? This should be a part of routine examinations. A watch in mechanical order becomes erratic if magnetized and unreliable, and may even stop if badly magnetized. If pallets are lubricated and no magnetism is present, make sure that the hands are not loose. The cannon pinion may be loose on center arbor or slipping part of the time. Test to ascertain that full friction exists and able to carry the hands all the time, and that there is no point at which the hands fail to carry. It could also be that the hour wheel tube binds on cannon pinion. Hour wheel and hour hands must be perfectly free at all times. Then note the balance wheel action in the dial and pendant positions; if the balance motion falls off sharply in any one position, locate the trouble at that position. It may be a bent or burred pivot, cracked balance hole jewel, pitted end stone, a short pivot not reaching cap jewel, excessive end shake interfering with jewel pin action so that the jewel pin passes too close to guard pin, or balance wheel touches center wheel, or balance might touch pallet bridge. By listening to the watch, your ear will quickly detect any variation in the sound action. The watch should have a clear ringing sound in all

positions. If you having a timing machine you can locate the trouble quickly both from the printed record or by using the ear phone. As a long shot, examine the hairspring for rust; a rusty hairspring will be the cause of constant and progressive losing time. Even a small spot of rust will make the hairspring useless.

Equalizing pendant rates

C. K.: I recently had a watch that I wanted to rate in five positions. It was for a special customer and I was anxious to please him. When I checked it, I found the rates dial up and dial down and pendant up were all alike, but pendant right and left were both slow. I know what to do when one is fast and the opposite slow, but I am at a loss in knowing what to do when both are slow. Why such rates and what can I look for to correct this condition?

Answer: Make sure that the balance is in perfect poise, then look to the hairspring, where you are most likely to find the trouble. If you had taken a reading pendant down compared with pendant up, you would have a slow rate, slower than the rates right and left. Your error is likely in the hairspring. The hairspring can be off center about the collet and causing unequal development, or the overcoil may require adjusting so that the spring is free between the regulator pins as close as possible, but not impinged. When these conditions are corrected, you will find that the right and left positions will agree with the pendant up position.

Train for 30-day watch

B. C.: I am planning to build a thirty-day watch by using a small Swiss movement and arranging the train, but want to add the extra wheels and extra long mainspring necessary to obtain a thirty-day run. Will you kindly suggest the number of wheels with teeth and pinion leaves necessary?

Answer: Your question does not give your writer all information required to give you a full answer as you do not state how many leaves there are in the center pinion. However, your writer will assume that the small movement you anticipate using has nine leaves in the center pinion. As the center pinion must make 30 times

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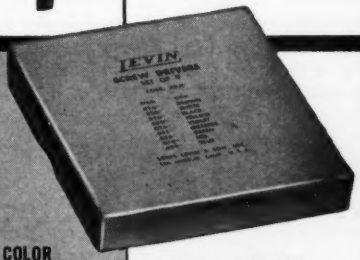

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24 revolutions, or equal to 720 revolutions for the month, and the mainspring will give six turns of power, consequently one turn of power must cause the center upper to make 120 turns and two factors of 10-to-1 and 12-to-1 can be used. As there are nine leaves in the center pinion, we can use 90 teeth in the second wheel, then using eight leaves in the second wheel pinion we can have 96 teeth in the barrel, and having six turns of mainspring power the results will be as follows:

$$\frac{6 \times 96 \times 90}{8 \times 9} = \text{720 revolutions of center arbor, or equal to 30-day run.}$$

An extra length mainspring is not required.

Keep repair jobs wound

D. S. D.: My employer is very particular about winding all repair jobs each day and at a regular time, especially for the high grade watches. Do you think that is necessary after the watch has been repaired and regulated?

Answer: Workmen accustomed to repairing high grade watches well know from experience that even a good watch showing a close rate and running as close as the workman is able to obtain will not continue to do so if permitted to run down. Its rate will be disturbed for several days and will show a variation greater than it had been doing and it may take several days to settle down again. However, it will settle down and return to its normal rate. Knowing this from the results of experience, the watchmaker seldom fails to wind all the watches on the repair board and even drops into the shop on Sunday morning to keep the watches running. This temporary irregularity is quite naturally unknown to many watch owners of fine timepieces and it is well to impress the importance of acquiring a habit to wind their watches regularly, preferably on arising each morning. The watch thus fully wound will then be able to stand and hold up against the many motions and jars it is so apt to be subjected to. Regular winding fully each day and not allowing the watch to run down are simple but very necessary things if its owner expects to look at his watch with confidence that it is performing and showing correct time.

Polishing a fork slot

G. B.: On a lady's small wrist watch when you find a small notch worn in the sides of pallet fork notch where the roller jewel hits, how do you go about smoothing this out like the original true and smooth condition? I find difficulty in selecting the proper tool to burnish out this notch true and smooth.

Answer: Fold a small steel mainspring and insert ends into a handle. The folded spring can be about 1¼ inches long. Heat the fold to prevent breaking the spring and also to get a close fold—the mainspring must be thin enough so that the folded spring fits freely in fork slot. If the pit marks are deep you can charge the folded mainspring with fine oil stone powder and oil. This will readily remove the pits or grooves, then with the same tool the fork slot can be polished by charging the springs with diamontine and oil. If the fork is made of soft material you can burnish a new surface by cross lining the mainspring with rather coarse lines using a coarse emery buff. The advantage of this tool is that when lapping out the grooves the tension of the mainspring spreading will maintain parallel sides of fork slot. Naturally, if grooves are quite deep it is advisable to replace a larger roller jewel.

First U.S. watch manufacturer

A. C. P.: Who made the first watches in this country?

Answer: There are no records as to who made the first watches in the United States. Soon after the adoption of our Constitution, several watchmakers or pioneers unquestionably began to make watches by hand for their own trade in limited quantities. The first attempt to produce watches in quantity was by Luther Goddard of Shrewsbury, Massachusetts, who began to manufacture watches in 1809. Even then, Luther Goddard did not make the watches outright. He imported parts in the rough from England and finished and fitted the parts to the plates in his factory. He was manufacturing at the rate of one complete watch per week until 1817 when he was compelled to give up, being unable to compete with imported foreign watches.

Use of dial washers

K. C.: There seem to be many pros and cons about dial washers. What are some of the uses of the dial washer?

Answer: Although it is not always necessary, the dial washer is useful and important. It is made of very thin copper foil and comes in assorted sizes and can easily be cupped with a pair of tweezers to the required curved shape. When used, the washer prevents the hour wheel from disengaging with the minute pinion. It will support the hour wheel, hold the hour hand from riding up and engaging the minute hand or catching over the second hand. Today the necessity of dial washers is a thing of the past.

Cleaning Incabloc jewels

A. C. A.: Will you explain an easy way to clean Incabloc jewels?

Answer: From one of our readers who kindly suggests his method for cleaning Incabloc jewels and which we are happy to pass on, we quote: "1. Release the holding spring to remove jewel assembly. 2. With tweezer hold assembly upside down in a small amount of benzene or cleaning solution, then the cap jewel will be released to bottom of receptacle."

True and poise balance, always

L. F.: Please publish the method to staff a balance not having to true and poise. One method I found to save time in replacing a broken balance staff in a watch recently cleaned is to remove the broken pivot by magnetizing a pair of tweezers. This often saves removing the dial and cap jewel. Be sure to de-magnetize.

Answer: No doubt many workmen would be very happy to learn of a method whereby a new balance staff can be staked to balance leaving the balance wheel perfectly true and in perfect poise. Your writer is always in a helpful mood, but I am at a loss to give you any formula or method. I have yet to have that experience of staking a balance and to find it perfectly true in flat and round, to say nothing

of poise. You can save time by using care when removing the broken staff by chucking the staff by the hairspring shoulder and cutting away the hub, so that there will be no strain when removing the balance. The wheel will remain flat and round and using care when staking the wheel to a staff will also help save time. The chances are in your favor that there will not be very much balance truing; however, you have no assurance that the balance was in poise to start with, so play safe and test for poise. Bear in mind that a poised balance is one of the main factors if you expect the watch to keep time. A balance out of poise cannot be seen like a balance out of round or flat, and take advice from one who is giving same for your benefit and for your own personal reputation as a first-class workman.

Your suggestion of magnetizing a pair of tweezers and then afterwards removing the broken pivot and de-magnetizing the tweezers no doubt works, but it seems that one could save time by removing the dial and hands, then remove the cap jewel and balance hole jewel for inspection. The cap jewel might be cracked, likewise the hole jewel. Besides, they should be cleaned and re-oiled. These precautions only take a few minutes, but pay out in the long run.

Discovery of magnetism

A. C. K.: Can you tell us something about magnetism—who discovered same?

Answer: The first magnets were found, not made. Approximately 2000 years ago it was discovered, states W. P. Keasby in the *Christian Science Monitor*, that a certain black iron ore had the power of attracting other pieces of iron. This ore has been found near the city of Magnes or Magnesia in Asia Minor and this magnet derived its name from the name of this city. More than a score of centuries ago it was discovered that a bar of iron would have the power of attracting iron after being stroked with a piece of magnetic ore, and in this way the first man-made or artificial magnet came about. A little more than a century ago it was found that if several coils of insulated wire were wrapped around a bar of iron and an electric current sent through the wire, the iron would act as a magnet. If the iron is soft, however, it will cease to act as soon as the flow of current ceases. Soft iron loses its magnetism rapidly. A hard, steel-like carbon or tungsten steel holds magnetism much longer.

Spacing cap and hole jewels

K. C.: During one of our meetings, the question as to what the fixed space between balance hole jewel and cap should be, and also as to the proper end shake for balance.

Answer: Most examining boards allow a tolerance of space between the balance and cap jewel of .02 mm. If the space exceeds that amount there is a danger that the oil will run away from the pivot, especially if light oil is used and capillary attraction fails to hold the oil. To get good rates the end shake must be held to not more than .02 mm.

Batteries for old electric

P. T. P.: I recently came in possession of an old electric clock. The dial is marked "New York Standard Watch Company." Magnets pull a bar fastened to the pendulum rod; this also has a knife-edge that closes a switch to make impulse. The batteries are missing. Where can I get proper batteries to set the clock running once more?

Answer: Clocks like you possess have been off the market for approximately 35 years. However, the clock was constructed to run on two 6" 1½-volt dry cells obtainable at any electrical supply house.

The following letters refer to items published earlier in this department:

Dear Mr. Samelius:

I have read the American Horologist and Jeweler for four years and have received a lot of help from it, but I cannot agree with A.J.V. in the October issue. He states that he has cleaned dozens of watches and the owners report that they have not varied over 10 seconds in two years. A standard beat watch vibrates 300 times in a minute, 18,000 times in an hour, and 432,000 times a day. To bring a watch to that close a tolerance, it couldn't be off over 25 vibrations in one year, and off only 25 in a year which would include 365 times 432,000.

I went to a school of watchmaking in a railway shop town where there were at least 150 men who carried railroad watches 16 size such as a B. W. Raymond, Waltham Vanguard and 992 Hamilton. They ran from 3 to 8 seconds

off in a week. I would like an answer in the Horologist as to whether I am right in my opinion and figures.

WALKER WATCH REPAIR
Box 33-A
Randleman, North Carolina

Answer: Your calculations are correct and the rates you give for the different-make railroad watches show you must be a careful workman as the rates are well within tolerance allowance. Your writer has had much experience on railroad work, but could not bring a watch to 10 seconds variation for a two-year run. Some years ago I was acquainted with a Washington, D. C., gentleman who was very precise about true time. He had a Waltham Vanguard 16S.

He was very regular in his habits, winding his watch at a regular stated time each morning and laying the watch in the same position each night. He kept a daily rate comparing his watch with the Arlington radio time, and at the end of 365 days his watch was 11 seconds slow. However, in checking the daily rate the watch had been as much as 35 seconds fast and 25 seconds slow. So you see even if the watch was very close to time at the end of 365 days, it had varied as much as 60 seconds. It might have been that if he had continued to keep his daily records that the watch would come back to the correct seconds. Even at that it would not have been a perfect timepiece.

Dear Mr. Samelius:

This letter isn't in keeping with the regular purpose of your column, but it is a grave subject. I would like to give my opinions on the subject of unions brought out in your May column. I have read the August and October comments and would like to hear more opinions. Mr. F.'s statement about telling an employer to go fly a kite and his theory about first class watchmakers never in need of a job, indicates he hasn't been around much on his own, or never bothers about the working man's troubles. A man can make out good if he is working for himself, but all good watchmakers as well as poor ones are not in a position to do so. A non-watchmaker-jeweler as well as those who are watchmakers might not have the time to do their own work, therefore the ones that are working for these jewelers are the ones in need of some kind of organization.

In my opinion, it is not a matter of being a first-class watchmaker as stated in your October column, but it is a matter of wages and working conditions. I know of several college men who were school teachers, but went into indus-

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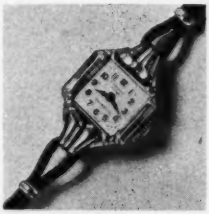

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try for a better living. I also know of many first-class watchmakers who are in industry for the same reason. In most cases, good watchmakers make less than unskilled labor.

A large percentage of store owners were and are watchmakers—a good reason why it is going to be difficult to help the man at the bench. Some of these bench men would not want to help themselves because they happen to know the right person to get a better deal, or possibly they expect to be a store owner some day themselves, so in this case the shoe would be on the other foot. I am not saying a union is the answer to the problem. How about guilds or some kind of state certification for all watchmakers? In my opinion the store owner should welcome some kind of an organization. They would recover good watchmakers from industry, get better workmanship from the ones they have, and they know the watch repair department can have a large influence on store traffic. What have they lost? They have gained in customer confidence and trade.

I must say I agree with Mr. Hay in the October issue on most points. If a watchmaker is good at his work, he has a profession not a trade, but if the trend continues as now, it will be a trade and a very poor one at that.

CHARLES D. AIRESMAN

Church Street
Ellerslie, Maryland

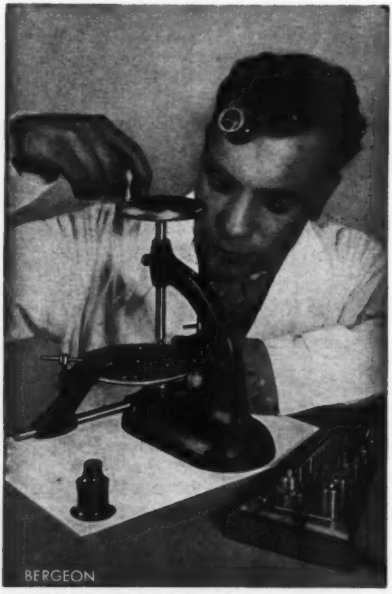
Dear Mr. Samelius:

Your correspondent, R. P., mentions a marine chronometer made by Appleton at 30 Southampton Row, London. This maker is apparently unknown but I have a very good chronometer made by Molyneux and Sons of the same address (30 Southampton Row).

The Molyneux family were well known chronometer makers at this address before 1840. Appleton may have been one of their employees. The piece referred to by your correspondent seems to have a very steady rate of 2 to 2½ seconds a week and changing the temperature compensation would probably do more harm than good. If the owner would ease back *one* of the regulating nuts on the balance by a twentieth of a turn or less, he would slow up the rate and perhaps get it nearer to mean time. Garrard's book, *Watch Repairing and Adjusting*, has an invaluable chapter on handling marine chronometers of this type. The *Manual for Hamilton Ship Chronometer* published by Bureau of Ships, U. S. Navy, gives minute instructions for repair of the Hamilton chronometer and with few exceptions is applicable to other makes. My own book, *The Science of Clocks and Watches* has a chapter on marine chronometers.

Yours truly,
A. L. RAWLINGS

87-77 146th St.
Jamaica, N. Y.



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Elgin Unveils Plaque in Honor of Samelius

■ A LIFETIME OF SERVICE to the American watchmaking industry and a career that spans the years from the days of King Oscar of Sweden was recalled when a bronze plaque was unveiled in Elgin October 26.

The plaque honors William H. Samelius, "dean of American watchmakers." His friends and associates at Elgin National National Watch Company unveiled it at an employees' recognition banquet. It will be mounted as a permanent remembrance at the Elgin Watchmakers College which Samelius directed for 32 years from 1921 until his retirement in 1953.

The almost-forgotten connection with royalty stems from the fact that Mr. Samelius is the son of William Knute Samelius, who was famous throughout Europe as watchmaker for the King of Sweden and for his ability in developing revolutionary type movements.

His connection with the future comes through Mr. Samelius' training of more than 4,000 graduates of the college he headed. Not only did he build the Elgin college into one of the leading horological schools in the country, but there are Samelius-trained watchmakers and jewelers from coast to coast.

Mr. Samelius was born in Belfast, Ireland, while his parents were on a tour sponsored by King Oscar of Sweden. When he was nine, his family immigrated to Chicago where his father died a year later and his mother established a boarding house to support her children.

The father's apprentice in Sweden, A. W. Johanson, had accompanied his master to the United States and was offered a place with C. D. Peacock, pioneer Chicago jeweler. It was he who taught young Samelius the watchmaker's art.

Many "firsts' have been recorded by Mr. Samelius. For example, he was one of the first to demonstrate how watchmakers' skills can serve the nation in time of war. During World War I, Samelius was chief inspector of U.S. ordnance and was instrumental in improving the accuracy of the famous French "75" cannon.

He was a pioneer educator in horology even before heading the Elgin college. In 1920, the Chicago board of education signed Mr. Samelius to teach watchmaking in one of their first technical schools.

Unveiling the plaque also recalled Mr. Samelius' fame as a lecturer, writer and consultant for state, regional and national horological associations and institutions. He has addressed horological societies, jewelers' conventions and schools throughout the nation. He holds many gold and silver lifetime membership cards in societies and institutes devoted to horology.

J. G. Shennan, Elgin president, unveiled the plaque after he had presented watches to 29 employees who have completed 25 consecutive years of service to the company.

The banquet also honored Elgin employees active in welfare programs, and reporters for the employee magazine.

Contest Winner

■ BY SELECTION OF THE JUDGES, J. E. Coleman, Nashville, Tennesse; Henry B. Fried, Flushing, New York, and W. H. Samelius, Pomona, California, the grand prize for the best A.H.&J. Watchmakers' Contest winning entry of the year goes to Mr. Fred Ammann, 275 West Thornton Street at Canal Bridge, Akron 7, Ohio.

Mr. Ammann's entry appeared in the November issue as No. 37 "Holding Clock Arbors To Polish Pivots," and he receives the first annual grand prize of a Bergeon waterproof case tester.

By J. E. COLEMAN

CLOCKWISE and Otherwise

Mr. Coleman invites your questions. If your question requires a direct answer, please enclose a self-addressed, stamped envelope. It is impossible through correspondence to give valuations of antique time-pieces; questions of this nature cannot be answered accurately.

Clock Repairmen Aren't Getting The Right Publicity

ONE IRON that *Otherwise* has had on the fire for many days is the debunking of a press story out of Richmond, Virginia, back in September. Now comes my copy of the clock collectors' bulletin wherein I learn that our association has awarded the principal of that story a membership in recognition for his work.

This does not complicate my plea for accurate reporting, however. At the very outset I want to make it clear—crystal clear—that I am highly pleased with that award and feel that it is one of the finest things the collectors' association has ever done. I am quite sure that out of all its vast membership (nearly 2,500) not another member shares any greater joy than this writer at seeing this young lad recognized.

The facts are, the very low status of the clock repairman today is somewhat due to failure and negligence of organizations like NAWCC in promptly recognizing and interesting our youth in things horological. That status is due far more to stories which, for one detail or another, leave the lowly repairman in a pretty bad light in the eyes of John Q. Public and this brings us to the thoughts we've had ever since one of our readers sent us the clipping.

The gist of the story is, a young lad of eleven years has repaired and set running a tower clock on a church in Richmond, Virginia, and one official reported that: "A clockmaker said it would cost about $2,000 to put the clock in order." Shades of Jesse James—what did that repairman expect to do to earn his two thousand bucks when an eleven-year-old lad did it in short order?

Inaccurate facts cause damage

■ ANY PRACTICAL CLOCKMAKER knows that a couple of thousand bucks will purchase one heck of a lot of repairing, especially where no outside scaffold or derrick work is involved and as this job was done by a small boy, this story precludes any of that type of work. From the photo we recognize the movement as a number 8 Howard tower clock, non-strike, and thus no strike mechanism is involved. We installed one of these identical movements not too long ago and the entire job consumed slightly over 225 man hours. At $2,000 that would have been almost $9.00 per hour.

That 225 hours covered the making of four complete sets of hands, making four 46-inch plate glass dials, making four tubular aluminum drive shafts, installing the dials and the false-work behind them to hold the dial trains and locating and installing the movement besides a thorough re-working of the entire movement.

These little clocks come down very easily—there are only three wheels in the train besides the main which is on the drum. As a rough estimate, I'd say a clockmaker could climb that tower, dismantle the clock, taking the two frame members and the train to his shop, do any neces-

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sary work such as re-bushing, making new bearings or re-pivoting, etc., return it, reassemble and have the piece going in under fifty man hours. But let's peg it at the fifty point. At $2,000 that would be $40.00 per hour.

Perhaps the reporter in his enthusiasm just added an extra "0" making $200.00 into $2,000, so if we keep our man hours at the fifty point, that would give us four bucks per hour—a reasonable figure, to say the least. Here, I think, is where the trouble sets in. In their enthusiasm to come up with a sensational story, reporters are prone to play fast and loose with both facts and figures and it seems to me that it always reflects on the poor repairman.

A most regrettable angle is that any writer or reporter can easily contact one or more of several unbiased mediums such as the Bristol Clock Museum (Bristol, Connecticut), Clock Manor (Denver, Colorado), the National Association of Watch & Clock Collectors, any of our trade journals or large horological schools and freely receive all the help and assistance he needs.

A couple of years back one of our large national weekly magazines ran a story of someone in South America (without checking) who claimed to have a mystery clock of sensational construction, etc., who was offering the "secret" for $100,000.00. Now you are immediately going to ask how the heck did that work to the detriment of the clock repairman?

Simple. We recall a long distance phone talk with one of the editors about that story and as I remember it, I was assured that it would be a long, long time before I ever saw a clock story in their publication again. Here chances for further publicity, possibly good, were wiped out.

It is an obligation, a solemn obligation, of everyone vitally interested in the repair industry to spike these detrimental stories at every opportunity. It can be done. Just watch the papers and magazines; you will not locate wild stories that even remotely reflect on the medical or legal profession. It is because John Q. would not believe them? Certainly not; every phase of the writing and reporting profession knows that they would have the medical association or bar association right on their necks even before the ink was dry. I know of no better spot than here for that old saw. "Either we hang together, or we hang separately."

Most of my readers know already and for those who don't I'll repeat, I bow to no man for my views on my chosen profession. Whether they be original or not is beside the point—they are modern, 1955. Somewhere in the distant past some group promulgated an idea that only three professions exist, i. e., theology, medicine, and law. Possibly such a definition fits the times for the whole of mankind was virtually divided into just two groups, the landed gentry and the hired help. A workman might become fairly proficient in a line by dint of long application and practice with little or no formal education whatsoever, and in those days he was called a tradesman and made to believe that he could not be a professional man.

A more modern definition is found in today's dictionary as: "That of which one professes knowledge," "the business which one professes to understand and follow for sustenance"; "calling"; as "the profession of lecturer on chemistry or mineralogy." There follows this quotation from Macaulay: "He tried five or six professions, in turn, without success." Certainly in Macaulay's mind it was not limited to three.

The fact remains that the medics, the barristers and the preachers lean very heavily on "ethics" and generally take that line with their argument for the "three" only. That old argument doesn't begin to hold water in 1955. Again, to the dictionary and we find that "ethics" is defined as "the science of human duty"; "containing precepts of morality."

In the days referred to above when the tradesman was required to go to the back door with his hat in his hand, etc., it was easy to promulgate a line of thought that he (the tradesman) need not have any concise ideas of morality or human duty—why, even slavery was looked on as being okay. In 1955 I can have just as high a concept of morality and of my duty to my fellow workmen, to my client and to my neighbor, repairing clocks as I could if I were expounding the gospel or doling out pills.

I would like to see our profession a little

more cooperative, a little more closely knit and am happy to report that there are plenty of indications of improvement in this situation.

We must keep plugging. You can always rely on your C. & O. to plug for clock-making and we try to take advantage of every opportunity.

U.S. clock history too well known?

■ JUST RECENTLY we were privileged to have a look-see at a new volume to be brought out soon by Simon and Schuster titled, "American Science and Invention," by Mr. Mitchell Wilson. About 425 pages and described as: "The fabulous story of how American dreamers, wizards, and inspired tinkerers converted the wilderness into the wonder of the world." ($10.00.)

We were amazed to find that no mention at all was made of the American clock industry and immediately got off the $64.00 question, "Why?", to the author He kindly replied promptly, saying in part: "The second reason, and this may surprise you, was that: I felt that the importance of the American clock had been stressed so many times and so well elsewhere, that readers would come to the book with this in mind and that I was adding to their knowledge by describing matters besides clocks." Naturally I still feel that the American clock was a vital cog in mass production and a very vital part of a story with such a title, but I will say for author Wilson, his reason is a new one and I've asked the "why?" of many authors.

The story mentioned beforehand re the mystery clock is a shining example of the lack of care some writers exercise before dashing off some sensational article. The clock (or principle involved) was not new, being well over a hundred years old. Clocks of their type are fairly plentiful, a number of them having been made com-

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mercially, some as late as 1910. Any practical clockmaker with a bit of experience could have "spiked" it in just about nothing flat, but those little gremlins who seem to continually dog every step of the bench repairman were and still are, so hard at work to avoid repeating such a break the management will just lay off clock stories. Let's each of us resolve to do just a little more cooperating in the new year.

Mr. Wilson's thinking that the clock and its making is already well known is the very first time I've encountered it. Generally, when we are disappointed at the omission of clockmaking where we think it is appropriate and fitting to the story and ask why, the answer comes that accurate and documented data was not readily available. We contend that it is. Should you be asked to help out on any publicity or stories relating to American clockmaking or American horology in general and not have it, call on C. & O. (card, letter or wire) and we will do our best to get it or tell you where to get it.

Elgin's telephone watch

■ ANSWER to the December "When Zit" —1916. In a trade journal for October, 1916, it was announced that the Elgin National Watch Company had brought out the telephone watch. We quote: "The attachment is simple and consists of a nickel-plated sheet metal holder which is clamped around the stand of the phone and fastened with a screw. It holds the watch there rigidly and always in plain sight. When vacation time or an extended trip takes you away from the office, it may be detached, a strap slipped through the lugs and you have the military model wrist watch for outdoor wear. Complete with nickel bracket and case, retail price $10.00."

For January we do not have a "what zit" or a "when zit," but rather a sort of horological "Believe-It-Or-Not" and trust that it will supply equal amusement.

Patent No. 568670 was issued September 29, 1896, to a gentleman of Evanston, Illinois, titled an improvement in mainsprings. The improvement consisted of the placing at points along the spring, small rivets with rounded heads, said rivets were set at regular intervals; on one side they were smooth with the surface, but on the opposite side they presented rounded heads, thus keeping the coils apart. The inventor wrote: "Stopping and inequality of motive power arising from contact of the coils of mainsprings is something from which all practical workmen have had unpleasant experiences. As a remedy for such annoyances, I have made this improved spring. It has been applied to over four hundred clocks which have been running from one to five years with entire satisfaction."

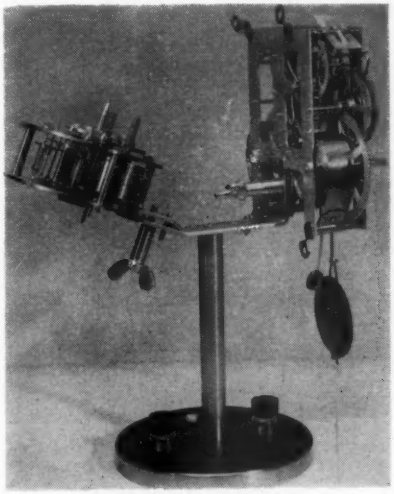
New tools aid repairmen

■ TOOLS ARE A PRIME ITEM in the life of every bench mechanic, thus a new tool is an appropriate starter for *Otherwise* for a new year. The very first for 1955 is a new movement (clock) holder from the house of Olsen up at 26 Templeton Parkway, Watertown, Massachusetts.

The Neslo (name reversed—their trade mark) movement holder is made with a five-inch diameter solid steel base on which is mounted a 3/8ths diameter steel rod some six inches tall. On the top of this post is fastened a 7/8ths wide horizontal bar, one end bent upwards at about a 30° angle and the other end bent at 90°—both ends terminate in a special Neslo screw clamp for clamping a clock movement. In recesses in the base are two leakproof small bottles for oil, pins, etc.

George V. Olsen writes that this holder is especially useful when adjusting and timing 400-day clocks — visible escapements, setting the strike levers on ship's bell clocks and will hold all one- and eight-day clocks, American or foreign clocks regardless of shape. The price is $12.95 (express will be prepaid on orders accompanied by check).

We have tried a number of movement holders and looked forward with interest to this one because we know that the house of Olsen is now in the hands of the third generation clockmakers and any tool from there has to pass a pretty severe practical test. The new feature is the 30% angle clamp. Heretofore similar holders have either been level (180%) or vertical for running and testing purposes. We have found that clamping the front plate at this angle makes for easier assembling since all the upper pivots will lean in the one direction, down rather than spiral as they do when the assembling is done with the front plate level or flat. Once all pivots are in and the back-plate on, it is a quick and easy switch to the vertical clamp for testing, adjusting, running, etc.



Olsen Movement Holder

A fellow clockmaker and neighbor, Gus Griffin, recently introduced me to a very worthwhile item. Evidently not new, as I understand that the dental labs have been using it for a while, but it was new to me and may be new to many readers. Simply a little rubber abrasive wheel, green in color, 1/8-inch thick by 7/8-inch diameter for use either in hand motor, in lathe or with flexible shaft. It is manufactured by the Dental Development and Manufactur-

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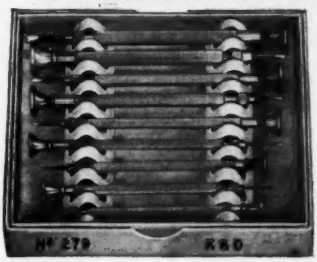

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We are grateful to W. Pruss of 4904 Wilson Avenue, Montreal, Quebec, Canada, and to William H. Allison of 1632 North Oak Street, Arlington 9, Virginia, who both sent in information on pigeon timers. This has already been passed on to Mr. Williamson and Mr. Hemmer (November issue questions). The following is a letter from Mr. Allison:

Dear Mr. Coleman:

I am sending you some information on pigeon timers. A friend of mine, Mr. Douglas Augustine, who is an official of the Arlington Pigeon Club, donated the material. The countermark under the paper clip is taken off the pigeon's leg after a race and placed in the clock over a cup and the result is printed as shown on the tape.

I hope this material will be of some use to you. I had written you a friendly letter before, and I read your column and think you are doing terrific work. Keep it up.

WILLIAM H. ALLISON

One more note on the Vermont Clock Company. Walter C. Robinson, Aquebogue, New York, writes: "Have for repair a clock by the Vermont Clock Company, Fair Haven, Vermont, a ship's bell striker, round turned case similar to Chelsea, but with the bell on the top of the case. Hammer shaft is vertical, extending through hole near top of case so that hammer is inside the bell.

"Movement is three-plate similar to Chelsea except that the rack and snail mechanism is between the front and middle plates and the escapement is on a round bridge behind the back plate covered with a round crystal. Lever escapement, seven jewels, very good workmanship throughout. Only wording on the dial is 'McMillan patent'." Any of our readers got a lead on the McMillan patent?

The many cards and heart-warming messages for the Christmas season were a source of added enjoyment to Jan and I, and we appreciate them very much. Everyone is saddled with additional chores, etc., incidental to celebrating Christmas and when anyone will take time out from this busiest of times to remember those they only know via the printed page, it is to us a true mark of sincerity. Both of us hope to visit you twelve times during 1955 via C. & O.

J. & J.

Taming a 'wild' 400-day

Dear Mr. Coleman:

I have a problem in attempting to make a 400-day clock run, a new one a friend of mine won as a door prize at a convention. In an unguarded moment I told him I would try and make it run. I have worked at the bench for years, but nowadays I have to cut out clocks mostly because I do not have the time.

I read carefully your question-and-answer department, the article on page 42 of the November issue, and I have also sent for a copy of the book, "Horolovar 400-day Clock Repair Guide." I am not a novice at the clock and watch repair game, but I do not seem to be able to make this clock run. I am sending you a rough sketch; the pallets are adjustable down and up, or one could say in and out of the locking on the escapement. There is no side shake on pallets or adjustment for same.

I observe that on the discharging pallet it has a tendency to scrape just slightly on the curved inside surface of the escape wheel. That is bad for it robs power and the clock stops after a few swings. When I set it slightly with less locking, then it flies back, the locking does not hold and I think the locking should hold and draw with no tendency to rebound or fly back.

I hesitate to widen these slots where

the pallets ride so as to move the pallet in a sidewise direction. What do you think? I checked points in your answer to an inquiry and have put it in beat several times so that lock would be equal. What can you advise me? I hate to be stumped.

I am a subscriber to A. H. & J. and once had some correspondence with you. You kindly sent me a twist of tobacco for my pipe. Thanks again.

FRED R. HAYWOOD
18 Market Street
Potsdam, New York

Dear Mr. Haywood:

We had plumb forgotten all about sending up the Tennessee tobacco. As I recall, it had something to do with the little photo friend George Martin uses to head up this column. Would you say it was more potent than what you grow locally? Anyway, it must have given you some idea of what I like in the old pipe.

There is practically nothing I can add on 400-day escapements over and above what you already have in the "Horolovar 400-Day Clock Repair Guide" because that portion of it dealing with the escapement, together with the most excellent drawings is, I think, quite complete.

It is noted that your immediate trouble is the locking and despite the fact that it is dead beat, the 400-day escapement possesses a tendency, as you say, to "fly back." Let us say that you have set the escapement correctly so that the tooth is dropping onto the locking side of the pallet and *not* on the impulse face. Try moving the fork "f" in Figure 11, page 22, a little closer to the suspension clamp "tb." That ought to correct your trouble.

There is a persistent tendency among repairmen to set the fork a bit low on the spring. Just why I don't know, unless it be a subconscious desire for more motion. It is true that the nearer to the pendulum it is clamped, the greater its arc of swing will be, but nothing is to be gained in

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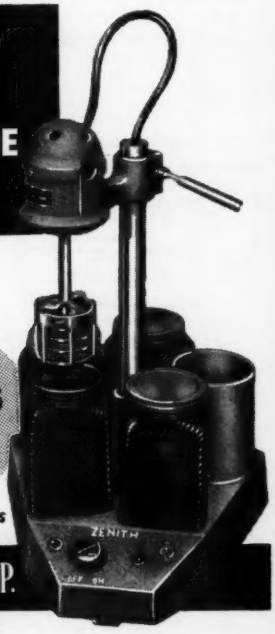

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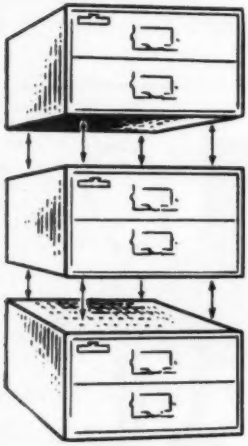

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Hence, to read the Caliper, multiply the number of divisions visible on the scale of the hub by 25, and add the number of divisions on the scale of the thimble, from zero to the line coincident with the line of graduations on hub. For example: —Suppose there are three divisions visible on the hub, and five registered on the thimble; multiplying the former number by 25 and adding 5, the number of divisions registered on the scale of the thimble, the result is eighty thousandths of an inch. ($3 \times 25 = 75 + 5 = 80$.) These calculations are readily made mentally.

Constant use will cause some slight wear on the gauge screw and on surfaces brought in contact wth objects measured. To compensate for wear of the screw, there is a taper nut on the hub A, which when turned to the right, contracts the hub, and causes the screw to be held more tightly. In making this adjustment, the sleeve D should be withdrawn only just far enough to use the small wrench furnished with the Caliper.

To compensate for wear on the measuring surfaces, turn the thimble so that the zero on the thimble will coincide with the zero on the hub. The small screw B should then be adjusted until its point will just touch the end of the spindle C.

The Caliper is made of steel, and the parts most exposed to wear are hardened.

The opening of the tool is 1 inch, and the direct reading on the main scale by means of the divisions on the thimble is given to $\frac{1}{1000}$. By means of a vernier the reading can be carried to ten-thousandths of an inch.

A distance, corresponding with nine divisions on the thimble, is set out on the fixed spindle of tool and divided into ten equal parts, so that each of these divisions is less by $\frac{1}{10}$ than those on the thimble. As the thimble is turned from one $\frac{1}{1000}$ to the next one, its division lines will successively agree with the narrower divisions of the vernier scale on the fixed part of the tool, giving the measurement to $\frac{1}{10000}$ of an inch.

In using these very fine measurements care must be taken that any wear of the tool must be adjusted, so that the zero of the tool when closed is absolutely correct, or the fine reading might be misleading.

ESCAPEMENTS.

The escapement is that part of the mechanism of a clock, or a watch, that checks the advance of the train and permits the energy of the weight or mainspring to "escape," at predetermined intervals, and give impulse to the pendulum or balance.

Escapements are divided under two heads: (1) Recoil escapements. (2) Dead-beat escapements.

Examples of recoil escapements:

The verge watch.
The crown wheel clock.
The ordinary recoil as used in most house-clocks.
The half-dead.

The recoil escapement has fallen into entire disuse in the manufacture of watches, because its timekeeping properties are so very much inferior to those of later design.

The crown-wheel, which is the verge escapement as applied to clocks has also become obsolete. The clock recoil or "anchor" escapement is more extensively used than any other form of clock escapement, and has undergone little change since its invention by Dr. Hooke more than two hundred years ago. It gives good enough results for all ordinary purposes, and can be easily and cheaply made. It gets its name of recoil because when the impulse is completed, the escape wheel does not remain at rest, but is driven backward some distance, owing to the form of the pallet faces. The recoil of the wheel tends to maintain a constant arc of vibration. Any increase in the force of the impulse, urging the pendulum to describe a larger arc, is immediately met by an increased resistance due to the increased force at the escape teeth, and to the increasing angle of the recoil faces of the pallets. Although the arc will not remain constant under great variations of impulse, a well-designed recoil confines the variation of arc within narrow limits.

The half-dead escapement is often used in good house clocks with half-seconds pendulums. It is constructed on similar lines to the Graham dead-beat, except that instead of the locking faces being true circles struck from the pallet centre, to give an absolutely dead rest to the wheel during the supplementary arc following

the completion of the impulse, they are formed to give a slight recoil. This is sometimes obtained by making the recoil face a straight line set back about 3 degrees from the locking corner, and sometimes by making it a curved face of increasing radius, giving a similar amount of recoil. Clocks with this form of escapement will carry much heavier pendulums than the ordinary recoil, and are usually very good timekeepers. The impulse arc is generally a little larger than for the dead-beat, 2° would do very well. Usually the faces of the wheel teeth are radial, but a dead-beat wheel could be used.

Dead-beat escapements are sub-divided into two distinct classes, " Detached " and " Frictional-rest."

Examples of detached escapements :

The Lever.
The Chronometer.
The Gravity.

Examples of frictional-rest escapements :

The Cylinder or " Horizontal."
The Duplex.
The Graham or " Dead-beat " clock escapement.
The Pin-wheel.

Detached escapements are so called because except during the act of unlocking and receiving impulse, the balance or pendulum performs its vibrations entirely disconnected from the train, whereas in the frictional-rest escapements, the balance or pendulum during the " rests " between each impulse. has to move against the continued pressure of the escape wheel teeth as they rest against the circular locking faces of the pallets. The detached escapement as applied to watches is far more perfect in principle than the frictional-rest, because it offers the minimum of interference with the naturally isochronal vibrations of a free balance and spring, but the comparative freedom of the balance from the possible variation in the effect of the train renders it susceptible to every change of temperature. When the temperature rises, the spring becomes less elastic, the vibrations are slower, and the watch loses ; when the temperature falls the spring becomes more elastic, and the watch gains. If a watch with a detached escapement is properly compensated, its time-keeping qualities are far in advance of any with frictional-rest escapements. All high-class watches have detached escapements, and no lever watch, even of the plainest kind, ought to be made without a compensation balance.

It is claimed for cheap uncompensated watches, that frictional-rest escapements have some advantage, as they possess what is called by Saunier a " natural compensation." An increase of temperature that reduces the elasticity of the balance spring, renders the oil more fluid and the motion of the balance more free, conversely a fall of temperature that increases the elasticity of the spring, causes the oil to get thicker and retard the motion of the balance, so if the parts of the escapement are properly proportioned, the oil of suitable consistency and clean, the two effects may, in a measure, counteract each other, but at the best such a method of compensation is imperfect and uncertain, is destroyed as soon as the watch begins to get dirty, and at no time gives such good and reliable results as those obtained from a compensated, but otherwise plainly made, lever watch.

A cheap modern lever with a ferro-nickel spring and a plain balance has a much smaller temperature error than any " naturally compensated " frictional-rest escapement.

There are two distinct actions in a lever escapement, (1) that of the wheel and pallets, (2) that of the lever and roller.

There are three kinds of wheel and pallet actions in ordinary use : (1) the ratchet wheel as used in most English watches, (2) the club-tooth as used in most Swiss and American watches, (3) the pin pallet as used in some of the continental watches. In the first kind the acting part of the wheel-teeth are points, the inclined planes producing the angular motion of the pallets being entirely on the pallets. It is claimed for this form that the thickening of the oil has less effect than with the club-tooth, and that as a consequence the watch will maintain its rate for a longer period without cleaning. The wheel is however delicate, and easily injured, it is not well adapted to retain oil at the acting points, and considerable " drop " is necessary to be sure that the discharge ends of the pallets shall be perfectly free of the backs of the wheel teeth during the whole of the unlocking. In spite of its drawbacks many English makers consider it the best. During recent years,

however, there has been a growing tendency to adopt the club-tooth in English work, especially in machine productions.

In the club-tooth the inclined plane is partly on the pallet, and partly on the wheel tooth, the club-tooth is much stronger than the ratchet, the back of the tooth being hollowed behind the heel tends to retain the oil at the point, and also gives such clearance to the pallets that scarcely any drop is needed.

A fault is that at one part of the action the faces of the tooth and pallet are nearly parallel, and if the oil has become thick or dirty the tendency to cling will become so great as to seriously disturb the rate and perhaps stop the watch altogether. This effect is reduced to a minimum in high-class Swiss watches by making the wheel of steel, bevelling the edge off top and bottom to almost a knife-edge, highly polished and smooth.

In the third kind the whole of the inclined plane is on the wheel-tooth, the pallets being small round pins or knife-edged pallets.

The wheel has some of the advantages of the club-tooth, while the effects of adhesion are no greater than with ratchet teeth; another advantage is that the leverage of the pallet arms, both for impulse and unlocking, is the same at each pallet, and remains equal throughout. With the club-tooth, and in a more marked degree with the ratchet-tooth, this equality cannot be. If the locking faces are at equal distances from the pallet centre (equi-distant lockings) the impulse arms are unequal. If the middle of each impulse is delivered at equal distances from the pallet centre (circular pallets), the locking faces will be at unequal distances. It may be that these inequalities are of little importance, as equally good results have been obtained with high-class English watches having either equi-distant lockings or circular pallets.

There are two objections to the pin-pallet escapement: it is difficult to retain oil at the pallets, and the resistance to unlocking at the exit pallet is much greater than at the entering pallet, because the same sloped face of the wheel tooth has to produce the draw and safe locking at each pallet, under very different angular conditions. Cheap German and Austrian watches have been made with this escapement, they appear to go well for a time, the pallets are inexpensive as they are simply two upright hard steel pins fixed in the lever, if they wear they are easily replaced. As it has never been used for high-class watches we cannot tell whether under suitable conditions it might not give as good results as the ratchet wheel.

There are various lever and roller actions in use. Good English watches have usually a flatted round pin, flatted away about one-third, so that it can enter the notch deep enough for action to take place right across its centre, and yet be short enough to be out of the notch when the action is completed. If the pin is left round, the action of the sides of the fork against it is very oblique, or there has to be a great deal of unnecessary run to the banking before the pin is out of the notch. Round pins should never be used. Triangular and oval pins are sometimes employed, if the edges are not left too sharp the action is similar to that of the flatted round pin, they are often made very wide with a view that in the act of unlocking more of the action occurs after the line of centres, but this is a doubtful advantage as we thereby cause more of the impulse action to take place before the line of centres, and the almost unanimous opinion of English makers is, that a moderately small and flatted round pin is best. (In Savage's two-pin escapement a wide unlocking pin, or pins, may be used to obtain an easy unlocking, because the impulse action is separate, that being given by the small guard pin in the lever acting against the narrow notch in the roller. In this escapement almost the whole action, both of impulse and unlocking, takes place on the line of centres. It is however a more difficult escapement to make, and unless well made is not good.)

When the impulse is completed, the wheel safely at rest on the locking, and the balance departed on its detached excursion, it is necessary that the lever should remain perfectly at rest, so that when the balance returns the pin may enter the notch freely to unlock the wheel; this is ensured, firstly, by the "draw," that tendency of the wheel to draw the pallets in towards itself, due to the inclination of the locking planes of the pallets and the undercut fronts of the wheel teeth; and secondly, by the banking pins which prevent the lever from being drawn beyond the required position. The inclination of the planes should be such that when the power is on, the wheel should always have a tendency to pass further down the locking plane and hold it securely, but no more than safe and certain

draw is necessary, if the draw is excessive, through the pallet faces being very much undercut, the unlocking will be hard, as the wheel has to be pushed back by the pallet before it can escape.

The banking pins should be at such a distance apart that the wheel may freely drop, the pin leave the notch, and the guard pin be quite free of the roller edge before the lever reaches the banking. The motion of the lever that occurs after the wheel has dropped, is called the " run to the banking."

The purpose of the guard pin is to prevent the lever from leaving the banking, or the wheel from leaving the locking from any abnormal cause while the balance is performing its detached vibration. If no guard pin were used, and the hands were set back, or the maintaining power failed, or from any accidental cause the motion of the train was reversed the wheel would pass backwards over the pallets, driving the lever from side to side. When the balance returned the lever might be at the wrong banking, and instead of the roller being able to enter the notch, it would strike violently against the outside edge of the lever, and the watch would instantly stop.

The soundness of the " guard " or " safety " action depends (apart from the correctness of its planting) upon the arcs of contact of the lever and roller. If low angled pallets are used, the motion of the lever is small, and if the roller is large, the intersection of the guard pin is so slight that the action is unsafe.

Suppose 8° pallets were used, and the radius of the roller from staff to ruby pin was equal to that of the lever from staff to notch, the balance arc would be only 8° and the intersection of guard pin would be practically nothing. When the radius of the lever is to that of roller as 3 to 1 (the usual proportion) the balance arc would be 24° and we get a greater intersection, but even then, with an ordinary roller, it is possible to force the guard pin past the smooth edge of the roller, and we do not obtain a sound safety action with pallets of much less than 10° (the balance arc then being 30°).

To enable the guard pin to pass the roller during the time the roller pin is in the lever notch, a crescent, or " passing hollow " is cut out of the roller edge in front of the ruby pin, the hollow must be deep enough to be quite free of the guard pin, and of such extent that when the roller pin leaves the notch, the guard pin is just out to the edge of the hollow. When a double-roller is used we may employ low-angled pallets, and a comparatively large impulse-roller, giving greater detachment to the balance, because the safety action is procured separately by the small roller. The guard pin is usually a stud, screwed or pinned to the lever, projecting some distance beyond the notch, and intersecting the small roller through a sufficiently large arc to make failure impossible. The impulse-roller requires no hollow, but the small roller has a deep hollow, to free the guard piece. As the intersection of the guard occurs through a larger arc of the balance than that of the roller pin, the lever must have wings extending beyond the notch so that if any backward motion of the train occurred after the impulse was completed, and before the guard piece was out of the passing hollow, the wings coming against the roller pin would prevent the lever from passing.

The stages in the action of a lever escapement may be enumerated as follows. Commencing from the position where the balance is returning from its free vibration.

(1) Unlocking—Performed by the roller pin entering the lever notch, carrying the lever with it, and thus drawing the pallet from under the wheel tooth.

(2) Impulse—The wheel after unlocking being free to move forward, communicates its energy by the inclined pallet plane, turns the lever round, and the energy is transmitted to the balance by the side of the notch striking the roller pin.

(3) Drop—As soon as the wheel reaches the discharge end of the pallet it drops on to the locking. The drop is a direct loss, the energy being expended in the blow on the locking plane, but it is necessary, to ensure perfect freedom.

(4) Draw—Which occurs as soon as the drop takes place, and produces the

(5) Run to the bankings.

6) Free or detached vibration of balance.

PENDULUMS.

Any body free to oscillate about an axis that does *not pass through its centre of gravity* is a pendulum. It will come to rest with its centre of gravity in a direct line below its point of suspension.

The vibrations of a pendulum may be performed in equal times, but the motion during the vibration is not uniform. It is ever varying, going fastest at its lowest position, and slowest (coming to rest for an instant) at its highest position at the end of each swing.

A " simple " pendulum is an ideal one, consisting of a single heavy particle suspended by a flexible weightless cord.

In practice an approximately simple pendulum is made by hanging a small heavy bob to a fine silk cord.

Every clock pendulum is a compound pendulum because it contains many particles.

The " equivalent simple pendulum " of any compound one, is a simple one that would have the same time of vibration.

The centre of oscillation of a compound pendulum is that point where if all its mass were collected its time of vibration would be unchanged.

The distance from the point of suspension to the centre of oscillation of a compound pendulum is its *effective length*, or *theoretical length*, or *time length*, and is equal to the length of its " equivalent simple pendulum."

To experimentally determine the position of the centre of oscillation of a compound pendulum, set it vibrating and hang beside it, or in front of it, a small bullet of lead or platinum suspended by a fine silk cord, and alter the length of the cord until the two pendulums have the same time of vibration. The time length of the compound pendulum is equal to the length of its equivalent simple one, and the centre of oscillation of the former is below its centre of suspension by a distance equal to the length of the simple one, measured from its point of suspension to the middle of the bullet.

If our compound pendulum consisted of a straight uniform rod suspended from one end and having no bob at all, we should find that it had the same time of vibration as a simple one two-thirds of its length. That is, the effective pendulum length of the rod would be two-thirds of its measured length, and its centre of oscillation would be two-thirds of its length from the end by which it was suspended.

Such a pendulum has four points of suspension about which it will have equal times of vibration, viz. either end, or a point one-third of its length from either end. If suspended from any point between the centre and one-third from the end the time becomes longer, and if suspended at the centre its time of vibration becomes infinite. It ceases to be a pendulum, has no tendency to oscillate and has become a balance. If suspended from any point between the end and one-third from the end its vibrations will be quicker than if suspended from either of those points.

Be careful to note that although a straight rod without any bob would be very simple from a mechanical point of view, it would not be what is called a " simple pendulum " as in that, the rod should have *no weight at all*, all the weight being in the bob, which should really be a point only. A straight rod without any bob would not be good for a clock pendulum, because for the same time of vibration it would have to be nearly half as long again as one with a bob. The centre of oscillation of an ordinary clock pendulum is at, or near, the centre of the bob, so the " length " of such a pendulum is the distance from the suspension to the middle of the bob.

In making a clock to a case of given dimensions it is well to remember that, owing to the relative effect of the different parts of a pendulum, its centre of oscillation may be above the centre of the bob, so that the bob has to be let lower down to get it to time, and if the train has been arranged with no allowance for such effect there may not be room in the case to let the bob down low enough. In house clocks, as a rule, the longer the pendulum the better the timekeeping, so the best use should be made of the available space, but it is advisable to allow a small margin for contingencies.

If, when the clock is finished, the nut touches the bottom of the case before the rate is slow enough, the difficulty may be got over by letting the nut up into

the bob; by reducing the weight of the upper part of the rod; or, by increasing the weight of the bob without increasing its length.

A pendulum is a falling body, moving down a curved inclined plane, its motion being governed by the laws of falling bodies. In the case of a simple pendulum we may regard it as a particle rolling down a smooth inclined plane, and the velocity gained will be proportional to the square root of the height it has fallen through. The time occupied will depend upon the length of the path as compared with the velocity gained. A short pendulum vibrates faster than a long one because the path travelled over is shorter as compared with height of fall. It really moves down a steeper path and so completes its journey quicker. The time of vibration of a simple pendulum is proportional to the square root of its length. A pendulum four times as long as another would take twice as long, one *nine* times as long would move three times slower, a pendulum to make one vibration in *ten* seconds would have to be *one hundred* times as long as a one-second pendulum.

In a compound pendulum every particle tries to vibrate in its own time according to the steepness of the path it describes, the particles high up, moving through short quick curves, try to swing faster; the particles low down, moving through long flat curves, try to swing slower, but all being rigidly connected they must swing together in the same time, so there is a point where the efforts of the particles below to retard the motion, are just neutralised by the efforts of those above to hasten it, and the point has the same time of vibration as it would have if it were free from the rest. This point is the centre of oscillation, and the vibration of the pendulum is exactly the same as the point would have if it were the bob of a simple pendulum.

Time of vibration of a pendulum is proportional to the square root of its length, therefore time *squared* is directly proportional to length. If we know the length of a one-second pendulum we can calculate the length necessary for any other time by simple proportion. We have only to multiply the length of the seconds pendulum by the square of the given time.

1 is the time of vibration in seconds of a seconds pendulum.

Let T = the time of vibration in seconds of any other pendulum.

$1^2 : T^2 :: 39{\cdot}14$; required length of the other pendulum.

$$\text{length} = \frac{39{\cdot}14 \times T^2}{1^2} = 39{\cdot}14 \times T^2.$$

The length of a *seconds* pendulum varies only when the acceleration due to gravity varies. In England, where g has an approximate value of 32·2 feet per second, the length of the seconds pendulum is 39·14 inches. At places near the equator where g has a less value the pendulum must be a trifle shorter. In high latitudes, where g has a greater value the pendulum must be slightly longer. In different places, for time to remain constant, length must vary in the same proportion as gravity.

Taking 39·14 inches as the length of a one-second pendulum calculate the length of a two-seconds one:

$39{\cdot}14 \times 2^2 = 39{\cdot}14 \times 4 = 156{\cdot}56$ inches $= 13{\cdot}05$ feet nearly.

What is the length of a half-seconds pendulum?

$39{\cdot}14 \times (\frac{1}{2})^2 = 39{\cdot}14 \times \frac{1}{2} \times \frac{1}{2} = 39{\cdot}14 \times \frac{1}{4} = 9{\cdot}78$ inches.

What is the length of a pendulum making one vibration in $\frac{3}{4}$ second?

$$39{\cdot}14 \times (\tfrac{3}{4})^2 = 39{\cdot}14 \times \tfrac{9}{16} = 22 \text{ inches.}$$

Similarly if the length of a pendulum be given we can determine its time of vibration by proportion. Divide the given length in inches by 39·14 and extract the square root of the quotient. The answer will be the time of vibration of the given pendulum.

What is the time of vibration of a pendulum 88.065 inches long?

$$\frac{88{\cdot}065}{39{\cdot}14} = 2{\cdot}25, \quad \sqrt{2{\cdot}25} = 1{\cdot}5.$$

The pendulum makes one vibration in $1\frac{1}{2}$ seconds.

Although it is often convenient to calculate the relative lengths and times of vibrations of different pendulums by proportion with the known length of the seconds pendulum, the student who offers himself for examination is expected to be acquainted with the recognised formula expressing the relation between time and length, and to be able to use it in solving any question.

When the question admits it the proportional method should be used.

The usual formula denoting the time of vibration of a pendulum is

$$T = \pi \sqrt{\frac{l}{g}}.$$

T = time of one single vibration in seconds.

(The " periodic " time of vibration is equal to a double beat, or a complete swing in each direction, covering the whole phase of the vibration from any point in its swing until it arrives at the same point *moving in the same direction.* This time is, of course, just twice as long as that of a single vibration and

$$T = 2\pi \sqrt{\frac{l}{g}}.$$

Pendulum calculations are almost invariably made from the time of a single vibration, i.e. a complete swing in one direction.)

$\pi = 3{\cdot}1416$ (3·14159 is more exact, but in all ordinary pendulum questions take $\pi = 3{\cdot}1416$).

$\sqrt{\quad}$ = the square root of.

l = length of pendulum.

g = acceleration due to gravity.

When length of pendulum is to be given *in feet* then g must be in feet = 32·2, but if length is to be in inches, g must also be in inches = $32{\cdot}2 \times 12 = 386{\cdot}4$.

$$(1)\ T = \pi \sqrt{\frac{l}{g}}, \text{ or } (2)\ T = \sqrt{\frac{\pi^2 l}{g}}, \text{ or } (3)\ T^2 = \pi^2 \frac{l}{g}.$$

When we have to determine the time of vibration of a pendulum of given length it is usually most convenient to use the formula in form

$$(2)\ T = \sqrt{\frac{\pi^2 l}{g}}.$$

Multiply the length by π squared, divide by g, and extract the square root for the answer.

$$\pi^2 = \pi \times \pi = 3{\cdot}1416 \times 3{\cdot}1416 = 9{\cdot}86965056.$$

As this is an inconveniently long fraction, it is usual to take it only to two place of decimals and then $\pi^2 = 9{\cdot}87$.

The length of a pendulum from suspension to centre of oscillation is 13·05 feet. What is its time of vibration ?

$$T = \sqrt{\frac{\pi^2 l}{g}} \text{ Taking } \pi^2 = 9{\cdot}87 \text{ and } g = 32{\cdot}2.$$

$$T = \sqrt{\frac{9{\cdot}87 \times 13.05}{32{\cdot}2}} = \sqrt{4} = 2. \quad \text{Ans. : 2 seconds.}$$

A pendulum is 88 inches long. What is its time of vibration ?

$$T = \sqrt{\frac{\pi^2 l}{g}} = \sqrt{\frac{9{\cdot}87 \times 88}{386{\cdot}4}} = \sqrt{2{\cdot}25} = 1{\cdot}5. \quad \text{Ans. : } 1\tfrac{1}{2} \text{ secs.}$$

When time of vibration is given and *length* has to be found the formula is used in this form $l = \frac{T^2 g}{\pi^2}$.

$$\left(\quad T = \sqrt{\frac{\pi^2 l}{g}} \quad \therefore T^2 = \frac{\pi^2 l}{g} \quad \therefore l = \frac{T^2 g}{\pi^2} \right)$$

What is the length in inches of a pendulum beating seconds, at a place where $g = 32{\cdot}2$ feet ?

$$l = \frac{1^2 \times 386{\cdot}4}{9{\cdot}87} = \frac{386{\cdot}4}{9{\cdot}87} = 39.14 \text{ inches.}$$

At any place where g has a different value l will vary in the same proportion as g.

$$32{\cdot}2 : g : : 39{\cdot}14 : l.$$

That is, for time to be constant when g varies, $\frac{l}{g}$ must be constant.

What is the length of a $2\frac{1}{4}$ seconds pendulum ? $l = \frac{T^2 g}{\pi^2}$

Taking $g = 32{\cdot}2$ and $\pi^2 = 9{\cdot}87$

$$l = \frac{(\frac{9}{4})^2 \times 32{\cdot}2}{98{\cdot}7} = \frac{81 \times 32{\cdot}2}{16 = 9.87} = \frac{2608{\cdot}2}{157{\cdot}92} = 16{\cdot}5 \text{ feet.}$$

What is the length of a half-seconds pendulum ?

$$l = \frac{T^2 g}{\pi^2} = (\tfrac{1}{2})^2 \times \frac{32{\cdot}2 \times 12}{9.87} = \frac{386{\cdot}4}{4 \times 9.87} = 9.78 \text{ inches.}$$

$$\text{or } l = \frac{{\cdot}5^2 \times 386{\cdot}4}{9{\cdot}87} = \frac{{\cdot}25 \times 386{\cdot}4}{9{\cdot}87} = \frac{96{\cdot}6}{9{\cdot}87} = 9{\cdot}78 \text{ inches.}$$

When the number of vibrations during some interval is given, instead of the time of one vibration, we may always remember that the interval divided by the number of vibrations gives the time of one vibration. If a pendulum makes 100 vibrations per minute $\frac{60}{100} = \frac{3}{5} = {\cdot}6 = T$ = time of one vibration in seconds, and

$$l = \frac{{\cdot}6^2 \times 386{\cdot}4}{9{\cdot}87} = \frac{{\cdot}36 \times 386{\cdot}4}{9{\cdot}87} = 14{\cdot}09 \text{ inches.}$$

What is the length of a pendulum making 90 vibrations per minute ?

$\frac{60}{90} = \frac{2}{3} = T$, and $l = \frac{(\frac{2}{3})^2 \times 386{\cdot}4}{9{\cdot}87} = \frac{4 \times 386{\cdot}4}{9 \times 9{\cdot}87} = 17{\cdot}4$ inches.

What is the length of a pendulum making 2,000 vibrations per hour ?

$\frac{3600}{2000} = 1{\cdot}8 = T$, and $l = \frac{1{\cdot}8^2 \times 32{\cdot}2}{98{\cdot}7} = \frac{3{\cdot}24 \times 32{\cdot}2}{9{\cdot}87} = \frac{104{\cdot}328}{9{\cdot}87} = 10{\cdot}57$ ft.

$T = \pi \sqrt{\frac{l}{g}}$ is the standard method of expressing the time of vibration of a pendulum.

From this the values of T, l or g may be determined when two values are known.

(1) $T = \sqrt{\frac{\pi^2 l}{g}}$ giving time of vibration when length and g are known.

(2) $l = \frac{T^2 g}{\pi^2}$ giving length when time and g are known.

(3) $g = \frac{\pi^2 l}{T^2}$ giving value of g when time and length are known.

Find the value of g at a place where a seconds pendulum had to be exactly 39 inches long.

$$g = \frac{\pi^2 l}{T^2} = \frac{9{\cdot}87 \times 39}{1^2} = 384{\cdot}93 \text{ inches per second.}$$

Find the value of g at a place where a two-seconds pendulum had to be 13·5 feet long.

$$g = \frac{9{\cdot}87 \times 13{\cdot}5}{2^2} = \frac{9{\cdot}87 \times 13{\cdot}5}{4} = 33{\cdot}31 \text{ feet per second.}$$

As the length of a pendulum is proportional to the square of its time of vibration, the square of the number of vibrations it will make in any given time must be *inversely* proportional to its length.

Therefore the product lV^2 is a constant for all pendulums for any given interval so long as "g" remains constant.

The length of a seconds pendulum multiplied by the square of the number of vibrations it makes in any given time is equal to the length of any other pendulum multiplied by the square of the number of vibrations that other pendulum will make in the same time.

A pendulum 39·14 inches long makes one vibration per second, $V = 1$, $lV^2 = 39{\cdot}14 \times 1^2 = 39{\cdot}14$ ∴ the length of any other pendulum, in inches, multiplied by the square of the number of vibrations it makes per second = 39·14. For instance a 2-seconds pendulum 156·56 inches long makes half a vibration in 1 second, then $lV^2 = 156{\cdot}56 \times (\frac{1}{2})^2 = \frac{156{\cdot}56}{4} = 39{\cdot}14$.

Let V = the number of vibrations in 1 minute, then for a 1-second pendulum $lV^2 = 39{\cdot}14 \times 60^2$, $39{\cdot}14 \times 60 \times 60 = 140904$, and lV^2 for any other pendulum = 140904. The required length of a pendulum for any given train is equal to 140904 divided by the square of the number of vibrations per minute.

I found this rule in use by workmen who had not the least idea what 140904 meant, or how it was obtained, but they got their results correctly. They knew that if they multiplied the number of teeth in centre wheel by the number in the third and by twice the number in the 'scape and divided the result by the number in third pinion multiplied by the number in the 'scape pinion they obtained the number of vibrations per hour and that if they divided that result by 60 the quotient = vibrations per minute.

$$\frac{C \times T \times 2S}{t \times s \times 60} = \text{vibrations per minute.}$$

This number squared and divided into 140904 gives the length of the pendulum in inches.

In a given train C has 96 teeth, T = 80, S = 32, t = 8, s = 8.

$$\frac{96 \times 80 \times 32 \times 2}{8 \times 8 \times 60} = 128 \text{ vibrations per minute.}$$

$$l = \frac{140904}{128^2} = \frac{140904}{128 \times 128} = \frac{140904}{16384} = 8{\cdot}6 \text{ inches.}$$

Another rule sometimes used says $l = (375{\cdot}4 \div V)^2$.

This is a modification of the same rule, as 375·4 is the square root of 140904.

$$\frac{375{\cdot}4}{128} = 2{\cdot}933 \text{ and } 2{\cdot}933^2 = 8{\cdot}6 \text{ inches.}$$

This method is not so popular as the first given, as it is rather clumsier, and 140904 being a whole number seemed easier to remember.

Probably the best workshop rule is the one founded on $l = 39{\cdot}14 \times T^2$, because no number has to be remembered except the length in inches of the standard pendulum, 39·14.

In the example already given $\frac{96 \times 80 \times 32 \times 2}{8 \times 8 \times 60 \times 60} = \frac{32}{15}$ = vib. per *second*.

Then this fraction turned upside down gives T = the time of one vibration in seconds.

$$T = \frac{15}{32}, \; l = 39{\cdot}14 \times \frac{15^2}{32^2} = \frac{39{\cdot}14 \times 225}{1024} = 8{\cdot}6 \text{ inches.}$$

If in this example the 'scape wheel had 30 teeth instead of 32 we obtain

$$\frac{96 \times 80 \times 30 \times 2}{8 \times 8 \times 60 \times 60} = 2 \text{ vibrations per sec., and } T = \tfrac{1}{2}$$

$$l = 39{\cdot}14 \times (\tfrac{1}{2})^2 = \frac{39{\cdot}14}{4} = 9{\cdot}785'' \text{ for a half-seconds train.}$$

A conical pendulum usually consists of a straight rod with a spherical bob. The bob describes a circle in a horizontal plane, the rod, during one revolution, traces out the surface of a cone, hence its name. The time taken by the pendulum to make one complete revolution is equal to the time of a double vibration (a swing in each direction) of an ordinary vibrating pendulum, the length of which is equal to the vertical height of the cone described. A conical pendulum of given length may therefore have different times of revolution according to the angle the rod forms with the vertical. As the rod leaves the vertical and approaches to the horizontal position the speed will increase because the cone will get flatter, and its vertical height less. When applied to a clock the end of the rod works in a slotted lever, driven by the train and communicating the energy necessary to keep the pendulum in motion. It is not such a good timekeeper as a vibrating pendulum controlled by an escapement, as any variation in the energy supplied to it will affect its rate, but because it is driven by a running train without any escapement the motion is continuous, it is therefore useful in measuring very small intervals of time, and for any purpose where a steady continuous motion is required. Such a pendulum is generally used for the driving clock of an equatorial telescope, enabling the astronomer to keep a celestial object in " the field " for any length of time.

The time of revolution of a conical pendulum may be expressed in two ways. Let h = the vertical height of the cone the pendulum is describing at any instant, T = time of revolution in seconds.

$$T = 2\pi \sqrt{\frac{h}{g}}$$

or,

Let l = the length of the pendulum, φ = the angle the pendulum is making with the vertical at any instant, h = vertical height of cone as in above expression. As $\frac{h}{l}$ = the cosine of the angle φ then $l \cos \varphi = h$.

$$T = 2\pi \sqrt{\frac{l \cdot \cos \varphi}{g}}$$

STRIKING CLOCKS AND REPEATING WATCHES.

Two kinds of striking works are in general use—the Rack and the Locking-plate.

The former is now almost always used in house clocks, carriage clocks, and small work generally. The latter is used in turret clocks, unless they are required to repeat, when the rack striking work is used for them also.

The striking work is usually driven by a weight or spring separate and distinct from that which drives the going part of the clock. (In old-fashioned 30-hour clocks one weight suspended by an endless cord or chain drove both trains. The objections to this are, that a very long fall is wanted, and that the weight necessary for the striking part may be considerably greater than is needed for the going part, but in some respects the arrangement is exceedingly good. The endless cord maintaining power derived from the driving weight itself is admirable in its simplicity and perfection, and is one of the many bequests left us by Huyghens, the eminent Dutch philosopher.)

The striking part consists of a train of wheels terminating in a fan or " fly " for the purpose of regulating the speed of striking; by this means, after running a short time, the tendency of a weight to accelerate its fall is balanced by the increasing resistance of the atmosphere to the passage of the fly, so that approximately uniform motion is maintained. If no such regulating arrangement were used the interval between the last two strokes in striking the long hours, twelve for instance, would be much shorter than the interval between the first two strokes of the same hour.

One of the wheels of the striking train has a set of pins or cams for raising and liberating the hammer, and another has one pin for arresting the train between the warning and the hour. Except during the processes of warning and striking, this part of the clock is absolutely at rest.

In the rack striking work the number of blows to be struck is regulated by the fall of the rack. The rack is a two-armed lever turning on a pivoted stud, the long arm terminates in a circular arc having teeth cut in it, the short arm or " tail " has a pin in it which falls against the snail. It has a spring sufficiently strong to throw it in to the deepest step of the snail. The rack is planted so that its teeth move just below, or in front of, the " gathering pallet." The gathering pallet has a single tooth, and is fitted on a square on the prolonged arbor of a wheel in the striking train which makes exactly one rotation for each blow of the hammer, so that one tooth of the rack is gathered up at each blow. In English rack clocks the gathering pallet has a long tail, which, as soon as the last blow has been struck, comes in contact with a pin in the rack and stops the striking train. In French clocks, usually, the locking is not done in this way, the gathering pallet has no tail, and the train is stopped by a pin in the gathering wheels coming in contact with a block on a pivoted lever. The lever is held out of the path of the pin during striking, until the rack is gathered home, the rack-hook being fixed on a square on the prolonged arbor of the stopping lever.

The snail is fitted on to the hour wheel, or on to a star wheel and jumper. The snail has twelve steps round its circumference, so arranged that when the rack-tail falls on the highest step only one tooth of the rack will have passed the gathering pallet, and consequently only one blow will be struck before the striking train is again locked. Each succeeding step allows the rack to fall one tooth further, the deepest step allowing twelve teeth to pass the gathering pallet.

The rack-hook is a lever with a hook at the end which fits into the rack teeth, and is of a ratchet shape, so that although it can be pushed out by the teeth as the rack is being gathered up, it will not allow the rack to move in the opposite direction, as long as it is in gear with it. It is raised by the warning lever high enough to free the rack and allow it to fall shortly before the time of striking. Some clocks strike instantaneously, but unless they are required to " repeat " as well as strike, they usually give " warning " first. The warning allows the rack to fall properly to rest on

the snail, and the rack-hook to be back in its place before the striking commences. The warning lever is raised and liberated by a pin in the minute wheel. It has a stop on the end of it passing through a slot in the plate so as to come in the path of a pin in the warning wheel when the lever is raised to its highest position. As soon as the rack falls the train begins to run, but is almost directly stopped by the pin in the warning wheel. Exactly at the hour the arm drops off the pin in the minute wheel, the warning lever falls out of the way of the pin in the wheel and the striking proceeds. The striking train usually contains four wheels and pinions, the great wheel fixed to the barrel or fusee driving the pinion of the second or pin wheel, which in turn drives the gathering pinion; the number of leaves in the pinion should be contained as many times in the number of teeth in the pin wheel as there are pins; the gathering wheel drives the warning pinion, the wheel teeth must be an exact multiple of the pinion, so that the pin in the warning wheel may be brought into the same position at the end of each blow; the warning wheel drives the fly pinion.

If the clock is required to strike a single blow at the half-hour a second pin is fixed in the minute wheel rather nearer the centre than the hour pin. In English clocks the first tooth in the rack is shorter than the others, the half-hour pin lifts the rack-hook high enough to allow the rack to fall one tooth only, to unlock the train and to give warning, but does not lift the hook high enough to allow the longer teeth to pass it. In French clocks there is no short tooth to the rack, the half-hour pin allows the stop-lever to be raised out of the path of the stop-pin and give warning, but it does not raise the hook far enough to permit any of the rack teeth to pass it; when the warning piece drops off the half-hour pin the stop-lever again falls in the path of the pin and stops it as soon as the gathering wheel has completed one rotation, during which time one blow will be struck.

The locking-plate striking work is governed by a train of wheels similar to that used for the rackwork, but instead of the rack and snail, a round disc called the locking-plate or count wheel is used to regulate the number of blows. The locking-plate may be a flat circular plate or a hoop-wheel, and there are many different ways of arranging the parts, but a description of one will be sufficient to illustrate the principle. The warning lever is raised by the pin in the minute wheel just as in the rack-work. It has two stops on it, one which locks the train when the striking is completed. the other, a little below and beyond the first, which arrests the pin in the warning wheel when the lever is raised high enough to give warning. Turning on the same centre as the warning-piece is a lever with a hooked end resting against the edge of the locking-plate. Notches are cut in the plate into which the hook or step at the end of the lever can fall when the required number of blows has been struck. During the lift for warning the lever is raised out of the locking-plate, the run from stop-piece to warning-piece carries the notch just beyond the hook, so that when the motion work lets the levers fall at the hour, the hook falls on the outer circumference of the plate, and as long as it remains there the clock will continue to strike. When one of the notches arrives under the hook it will fall into it, and the warning-piece falling with it will come into the path of the stop-pin and arrest the train. The locking-plate makes one rotation in 12 hours, and may be considered as marked out into 78 divisions, with notches cut at the distances 1, 3, 6, 10, etc., so as to allow the clock to strike 1, 2, 3, 4, etc., in regular succession. The plate may be fixed on a wheel of the train that makes one rotation in 12 hours, or it may have a wheel of 78 teeth fixed to it and turn on a stud; in this case the arbor of the third wheel is prolonged and carries a gathering pallet to shift the wheel one tooth at each blow, a spring jumper resting against the wheel to prevent it shifting. This arrangement has the advantage that if by any accident the striking should get wrong, the locking-plate can be set to its correct position without striking the clock round. When the plate is fixed to a wheel in the train, and by any accident the striking is let off, it will strike the next hour and will continue to strike an hour in advance, so that the hour hand must be shifted to correspond with the striking, and the clock

stopped for an hour, or it must be struck round to the correct hour again. The notches for one o'clock and two o'clock are made into one wide notch, because the lever has not to rest on the rim of the wheel to strike one blow, the act of giving warning ensures the striking of one before the train can be locked again. If a single blow is required at the half-hour the plate is considered as having 90 divisions, and if attached to a gathering wheel that wheel must have 90 teeth. Each notch is made 4deg. wider to allow the half-hour to be struck before the hour step is reached.

Quarter-clocks have an independent weight or mainspring to drive the chiming part. Its action is regulated by a train of wheels similar to the striking train. Very often the fly is a regulating one, instead of one fan there are two, sprung on a pivot at each end of a crossbar on the fly pinion; they can be turned on the pivots to offer more or less resistance to the air, and so adjust the speed of chiming. The number of quarters to be struck is governed by a rack and a four-stepped snail in rack-clocks, and by a locking-plate making one rotation in one, two, or three hours in the other kind of clock.

Clock-watches, or watches that strike the hour like a clock, are seldom made. They are costly, and not so suitable for many purposes as a repeater.

Repeating watches are those in which the time may be struck at will. In the old repeaters the striking mainspring was wound by pressing in a knob at the pendant. In modern ones it is wound by moving a slide round the band of the case. In unwinding, the spring drives the repeating work, striking the last hour shown by the hands, and then the number of quarters past the hour. Some strike also the half-quarters, others strike the hours, and the number of five-minute intervals past the hour, while others strike hours, quarters and minutes. Ancient repeaters struck on a bell, or on a dumb block fixed to the case. Modern ones strike on a circular spring or " gong " screwed to the plate. The methods of arrangement of repeating motions vary considerably, but the general principle is much the same in all, and the method of regulating the number of hours to be struck is similar to that used in the rack striking work of an ordinary clock.

The repeating mainspring has its outer end attached inside a small barrel fixed to the plate; the inner end is hooked in the usual way to the barrel arbor which is connected by a click and ratchet work to the main wheel of the running train of small wheels used to regulate the speed of striking. Two plans are in use for ultimately regulating the speed. In the one the last pinion of the repeating train runs in an eccentric bush, which may be turned by a screwdriver to alter the depth of the pinion with the wheel that drives it, and so regulate the speed. In the other the train terminates in a small running escapement with an adjustable banking. When the banking is opened, the escape wheel runs further up the pallet plane and the motion is slower; when the banking is close the wheel runs through quickly. When the escapement is used, fewer wheels are required in the train, but if well made either plan appears to be equally durable and effective.

In the watches first made a lever pressed in by the pendant knob had one end of a chain attached, which, after passing round a guide pulley on the plate, was wound round a pulley on the barrel arbor to wind up the spring. In modern ones the lever terminates at one end in a circular rack, or segment of a wheel, gearing with a small steel wheel squared on to the barrel arbor. This small wheel has one of its spaces uncut forming a stop-piece. The mainspring is " set up " some distance before the rack is placed in position, and can then be wound nearly a full turn, the blank piece of the wheel acting as a stop, top and bottom.

On the barrel arbor, in a sink below the winding wheel, is a squared steel ratchet having twelve teeth round about one-third of its circumference (the rest of the teeth being entirely removed). As the spring is wound the twelve teeth pass successively in front of the hammer pivots and in returning have to lift the tail of the hammer to strike the hours. The number of teeth that pass the hammer, and consequently the number of

hours struck, is regulated by a projecting arm on the winding rack coming in contact with one of the steps on the hour snail. The hour snail has twelve steps on it, and is fixed to a twelve-toothed star kept in position by a spring jumper with a V end. When the projecting arm is opposite the deepest step of the snail it can go in far enough to wind all the twelve teeth past the hammer; when opposite the highest step it can only go far enough to wind one tooth past. The hour snail is shifted at each hour by a piece projecting from under the quarter snail on the cannon pinion.

The parts must be so adjusted in position that all the twelve teeth must safely pass the hammer just before the winding rack reaches the stop of the winding wheel; in running back the arbor will then have nearly half a turn to run after the hours have been struck, during which time a gathering pallet squared on the barrel arbor catches a projecting piece on the quarter rack and carries that home to its locked position. The quarter rack has three teeth cut on each end of it which act on two separate hammers to give a ding-dong for each quarter. (Sometimes the interval between the two blows is too long or too short. If the blows follow one another too quickly the interval may be lengthened by shortening the pallet of the first hammer so that it drops off the rack sooner. If the interval is too long the pallet of the second hammer may be shortened. Care must be taken, however, to observe that the intersection is sufficient to allow of shortening; if not, a longer pallet must be fixed to the second hammer to lengthen the interval, a longer one to the first hammer to shorten the interval.)

An arm on the quarter rack falls on a four-stepped snail fitted on the cannon pinion to regulate the number of quarters struck; when it falls to the deepest step all the teeth on the rack pass the quarter hammer tails and three-quarters are struck, when it falls on the highest step none of the teeth pass and so no quarters are struck. Underneath the highest step of the quarter snail, and of the same radius, is a segment of a disc turning freely on a colletted centre of the snail, its motion being limited by a slot and pin. This is called the surprise piece. Fixed to its underside is the block for shifting the hour star and snail. When it first reaches the star it is pressed back by the block to the extent of the slot, so that its face does not project beyond the face of the highest step of the quarter snail, or it would be in the way of the quarter rack when falling to the deepest step. As soon as the hour star jumps, the block which nearly fills the space between the star teeth is driven forward, carrying the surprise piece to the other end of the slot with its face projecting ready to prevent the quarter rack from falling to the deepest step. If no surprise piece were used, and the watch repeated directly after the hour had changed, the three-quarters might also be struck.

When repeaters were first made it was found that the hours were not always correctly given, because the operator did not push the lever home to the snail. If, for instance, at 12 o'clock it was only pushed half-way down the snail, it would only strike 6 instead of 12 (some cheap Swiss repeating watches are being made at the present time without the all-or-nothing piece, but they should be avoided as imperfect and unsatisfactory specimens of watchwork). This objection was removed by the invention of the all-or-nothing piece, an arrangement by means of which either the correct hour would be struck or nothing at all. The old repeaters were arranged with a movable star, modern ones have usually a fixed star. In the former the all-or-nothing piece is a long lever turning on a pivot at one end and banked to allow it to turn a short distance on its stud. A weak spring keeps it pressed towards the winding and quarter racks. The end of the lever farthest from the pivot fits into a step in the quarter rack when that is carried home by the gathering pallet, and locks it securely there so that it cannot fall when the barrel arbor is first wound. The pallet for lifting the hour hammer turns on the pivot and has a pin projecting upwards from it, as the quarter rack is gathered up it presses against the pin, turning the pallet round out of reach of the striking ratchet, so that as long as the quarter rack is locked no hours can be struck. The hour snail

and star are pivoted on a stud at about the centre of the all-or-nothing piece, and move with it. When the winding rack is pressed home to the hour snail it pushes it on one side, moving the lever with it and unlocking the quarter rack. As the latter falls, thrown in by a strong spring to the quarter snail, the tail of the hour hammer is released and brought into the path of the striking ratchet by a weak spring. As the main spring unwinds, the hours are first struck, then the gathering pallet moves the quarter rack round to strike the quarters, turn the hour hammer tail out of action, and press the all-or-nothing piece back until the step is reached, when it is again locked.

When the fixed star is used the hour snail and star turn on a stud screwed in the plate. The all-or-nothing piece is a long spring fitted round the edge of the plate, and having a step at its extremity for locking the quarter rack similar to the other arrangement. The action of the quarter rack and hour hammer tail is the same in both kinds. The arm on the winding rack that reaches the snail is not a solid part of the rack, but is pivoted or slotted to it. When the arm reaches the snail it is pressed home to the rack and turns a little way round on its pivot. It has a long tail lying across the rack which presses against one end of a click piece pivoted on the rack which has its other end against the all-or-nothing spring. When the arm is pressed against the snail the tail end turns the click round, the click in turning pushes the all-or-nothing piece back far enough to unlock the quarter rack and the striking proceeds.

In Reid's treatise, plate XIII., page 328, will be found an illustration and description of a repeating motion with movable star, and in " Saunier's Modern Horology," plate XVII., page 795, one with a fixed star. See also Britten's Handbook, Article " Repeating Watches."

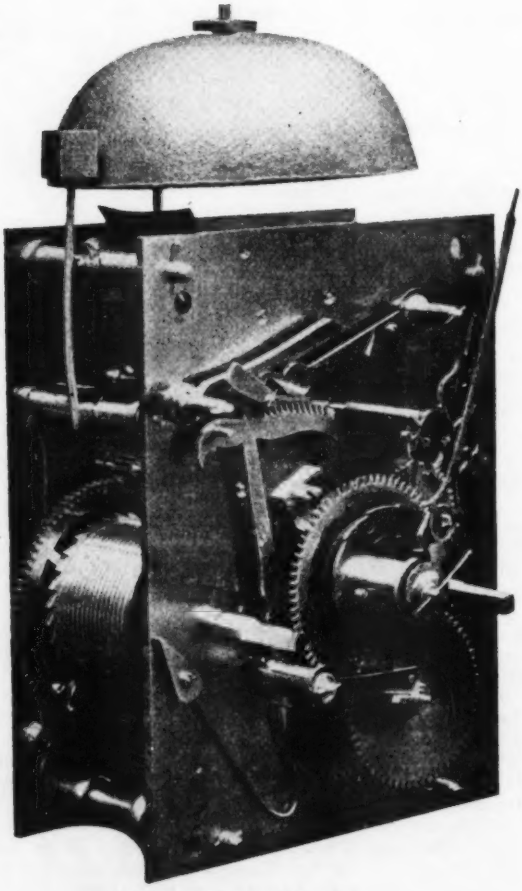
In half-quarter repeaters the rack is made in two pieces turning on the same centre, one above the other. The lower one is the quarter rack, with three teeth at each end to give a ding-dong for each quarter. The half-quarter piece is immediately above it, and has one tooth only. A pin projects from the quarter rack into a slot in the half-quarter one, which allows the latter an independent motion in advance of the quarter rack by an amount equal to rather more than the pitch of the lifting teeth. The half-quarter rack is kept in either position by a spring catch. When the upper rack is pressed back by the snail, the two rack tails are exactly over one another; the single tooth is over one of the other teeth so that it can produce no independent blow, and the whole action is precisely the same as in a simple quarter repeater. The striking of the half-quarter blow is regulated by the snail on the cannon pinion. It consists of two snails fixed together, the lower one, similar to the ordinary four-stepped quarter snail, is in the same plane as the quarter rack. The upper one, which is in the same plane as the half-quarter rack, has its first step half-way along the highest step of the quarter snail, and its other steps similarly commence midway between the quarter steps. During the first half-quarter after the hour, the tails of the two racks will be received as one on the double part where the two snails correspond, and no blow at all will be struck. During the next seven and a half minutes the quarter rack will still be prevented by the quarter snail from falling far enough to lift, but the half-quarter piece is now free to fall over the first step in its snail and bring its own single tooth beyond the quarter teeth and lifting pallet, so that as it is gathered up it strikes a single blow. At the end of the first quarter the quarter rack will fall over its first step, and thus fall far enough to strike one quarter in returning, but during the first half of this second quarter the half-quarter rack is received by its snail on that part, where it has the same radius as the quarter snail, so that it cannot move in advance of the quarter rack. Halfway through the quarter it will be again free to advance beyond the quarter rack. Similarly during the first half of each quarter it will be held back by its own snail so that it can do no independent work, its single tooth coinciding with one of the quarter teeth, and the whole piece acting as part of the quarter rack. During the second half of

each quarter it can advance beyond the quarter rack, bring its single tooth into independent action, and strike the single blow denoting the half-quarter.

Five-minute repeaters are less complicated than half-quarters, the rack is single, has eleven teeth on it for raising the five-minute hammer, and its fall is regulated by a 12-stepped snail on the centre arbor. In other respects it is much the same as the simple quarter repeater.

The minute repeater has a double rack, the upper one has 14 teeth cut on it for raising the minute hammer, the fall of the minute rack is regulated by a four-winged snail on the centre arbor, each wing being a snail with 14 steps on it. An illustration and description of the minute and quarter racks of a minute repeater is given in the " Horological Journal " for September, 1892, page 8. See also Britten's Handbook, ninth edition, pp. 309-310; tenth edition, p. 340.

FIFTH Sectional insert of "Technical Horology"



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doing so because the impulse power still remains just that arc while the point of the escape wheel tooth travels across the impulse face of the pallet. We must have a positive lock—that is, the pendulum must have a little bit of turn beyond and after the tooth drops onto the locking surface, but that is all that is necessary.

The 400-day clock operates on precious little power and that tooth drops onto the locking side of the pallet with very little force, yet this "back-lash," or "kick-back" is many times a source of much trouble. The less the distance between fork "f" and the clamp "tb" is, the stiffer in effect that portion of the suspension spring is. In other words, the more resistance it offers to this "kick-back" effect.

This whole feature of the 400-day escapement is often baffling to the watchmaker. He has become so accustomed to working with watches on which the pallet has "draw" or "draft," i. e., that tendency of the escape wheel tooth, by reason of drawing on the angle of the locking side of the pallet jewel, to hold the fork over against the banking pin while the balance wheel continues its excursion.

The dead-beat escapement is exactly what the term implies, that is, by reason of the fact that the locking surface is a curve whose center would be the pallet arbor pivots, it is completely dead. Each point on that locking surface is the same distance from the pivot point as every other point on that surface, thus the tooth pressure does not force the pallet in any direction.

You mention widening the slot which holds the pallet in order to move the pallet in a sidewise direction. This is never necessary. Now it may be that an escapement has been tampered with and a greater distance is required between the tips of the pallets, but you get this spread by sliding the pallets upward in their slots, not by widening the slot. When doing this, it often becomes necessary to close the distance between the escape wheel center and pallet arbor center.

All 400-day clocks have some form of adjustment, either an eccentric button for the back bearing on the pallet arbor, or the bearing is in an arm that may be bent. This is thoroughly covered on pages 8, 9, 10, 11 and 12. I shall be anxious to know how well and also how quickly you succeed in subduing this "wild critter" and am, therefore, sending along an addressed card for some word. J. E. C.

Levi Smith wood movement

Dear Mr. Coleman:

I recently acquired an old clock and on arriving home with it and in attempting to have it fixed, I found the works are made entirely of wood. I mentioned this to a friend of mine who is a watch man and he felt the clock was rather valuable and gave me your name suggesting I write you, indicating you were an authority on old clocks and it was your hobby. He stated you probably knew more about old clocks than anybody in this country.

Not being at all familiar with clocks, I am sending you a rough sketch which should enable you to identify it. As mentioned, the works are made entirely of wood, and the name of the maker of the clock is Levi Smith, Bristol, Connecticut. This clock was made and sold by him. There is no date within the case itself. I obtained the name of Levi Smith from a paper warranty pasted on the inside. There are three names written on the back indicating dates of repair, the oldest being, "Cleaned by D. Burton, Nov., 1851."

As I have mentioned, I know nothing whatsoever about clocks and I trust that perhaps you can give me some information as to its value if it is at all unusual. I would appreciate your addressing your reply to my address below.

CHARLES M. AMS
R.F.D. No. 2, Tashua Road
Stepney Depot, Connecticut

Dear Mr. Ams:

Appraising or valuing antique timepieces is a specialty and can best be done by one trained in that line after he has actually examined the piece, and we state at the heading of the column that we do not invade this field.

The clock in your sketch is called both an ogee style and a picture frame, either term denoting the style of case. Wood

movement shelf clocks first came in about 1815, really getting into production about 1820 and ceased with the great business depression of 1837. Levi Smith was one of the Bristol, Connecticut, makers active during this period. Palmer lists a firm of Smith and Blakesley at Bristol, composed of Levi Smith and Augustus Blakesley, as being active about 1830 and that Mrs. Ester Ross of Ardmore, Pennsylvania, has an ogee clock with that label in it.

A later firm, these same two gentlemen plus Edwin Ray, known as Smith, Blakesley and Company, is listed as being active about 1840. Smith continued alone after 1842 making clocks until 1846 in what was later known as the Noah Pomeroy shop on Federal Street. It isn't at all likely that he was making any wood clocks during this period, therefore he must have operated under the "Levi Smith" label before the Smith and Blakesley firm of about 1830.

Wood movement clocks are all considered of some value and especially when in good order and capable of being restored to original order without too much work. Since none have been manufactured since 1837, the youngest of them are 117 years old. There are a good many in circulation but they are very much sought after and consequently they are growing scarcer by the year.

These clocks were never dated by their makers and we take no particular note of repair markings. First, each individual repairer merely had his own marking system and that only as a date against his one-year guarantee; second, markings can so easily be added or forged by anyone at any time. Now, if you happen to know something of the history of this clock, say, for instance, that it had been in the county in which you first located it, you might locate D. Burton, clock repairer, in some of the county records around 1851 and thereby authenticate that marking. You have a fine old clock, one that will be a faithful timekeeper when it is repaired—an hourly reminder of Connecticut life a hundred years ago.

J. E. C.

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Tipton clock

Dear Mr. Coleman:

We have in our shop an eight-day, calendar dial, second beat, hour strike grandfather clock. The name "Tipton Ludlow" is engraved on the dial as per the tracing I am sending you. The names "Walker & Hughes" and "Birmingham" are cast in the iron dial back plate.

The clock is operated by an 8½-lb. bell weight and an 11½-lb. time weight, both made of lead with no outer shell. The clock uses a round iron pendulum wire and a round, discus-shaped pendulum bob of cast iron with a brass center ornament weighing about 26 ounces.

The case is approximately 6½ feet tall with a hood that slides to the front to be removed. The hood top is of the swan's neck type and there is a brass ornament fastened to the front of the top of each swan's neck. There is a hollow round brass finial as a top center decoration; there are hinged doors in the front of the hood and in the center portion of the clock.

There are two small pieces of marquetry on the front of the case which is made of oak with walnut veneer trim. There does not appear to have been any mahogany in its makeup. We believe the clock is English and we would like to know something about the maker and the dates within which it was probably made. We would appreciate obtaining this information.

R. R. ROBERTS

22 West Sixth Street
Jacksonville 8, Florida

Dear Mr. Roberts:

The dial you sketch looks definitely English of the late 1700's and early 1800's period. We do not locate a "Tipton Ludlow" in any of the listings, but think this clock was made by Benjamin Tipton of Ludlow, a small town about 35 miles west of Birmingham, England. One "Benjamin Ludlow" is listed as being an active long case clockmaker about 1776 there.

The "Walker & Hughes, Birmingham" denotes a firm of ironmongers who cast and furnished the iron false dial plate. I want to compliment you on giving a full and complete description of the clock.

J. E. C.

Skipper wants reverse clock

Dear Mr. Coleman:

I am a Chief Engineman whose hobby is repairing watches. The captain asked me to rig an electric wall clock so that it will run backwards. It is to be a novelty over his bar. Any information on accomplishing this will be greatly appreciated.

BILL CARROLL, ENC (SS)
USS Segundo (SS 398)
c/o F.P.O., San Francisco, California

Dear Mr. Carroll:

Glad to have a query from the Navy. I understand that you fellows have washing machines now. Back in 1917 all we had for cleaning whites was a bar of salt water soap and a Ki-Yi, and a little later on, after one had learned a few of the tricks, it was possible to bribe someone in the black gang to allow you to slip down and use a steam hose to bubble live steam through the whites as they soaked in a pail.

You do not state whether you desire to reverse a clock already in service, or if one is to be purchased. If the clock has yet to be purchased, your problem is a small one. Get a GE or Telechron, then all you have to do to reverse it is merely turn the field coil over.

This method will work on any self-starting synchronous clock, but many on the market have their coil built in, so to speak, such as the Hanson, etc. On any of the movements like Sessions or United, whereby the hands are propelled by a worm drive, it would be very difficult to accomplish the desired result. On clocks driven by pinion like the Hanson, etc., one has merely to set the motor to one side a bit and interpose between the motor driving pinion and the clock, a new pinion of identically the same size and number of teeth as is already on the motor pinion.

The field poles of the GE and Telechron are held astride the rotor unit by only two screws. Back them out, turn the pole and coil assembly over and replace. It won't take much longer than it required to write this last paragraph. So doing reverses the motor and the clock will perform just as well going left as right.

J. E. C.

Motor to operate long hands

Dear Mr. Coleman:

The last time you heard from me was from Indonesia. I have since returned to the States and I am still enjoying your interesting and helpful articles in Clockwise and Otherwise. Can you please advise me what type of an electric motor I should obtain to operate the hour and minute hands of an R. Whiting, Winchester-type dial of a former wooden clock movement? I would appreciate it very much if you would be so kind as to airmail your reply to my address below, besides publishing the reply in your column.

ERNEST F. KRONER
Center Conway, New Hampshire

Dear Mr. Kroner:

The former correspondence is remembered, especially the unusual way the envelope was addressed. Glad that you are back in the U. S. and also to note your letterhead.

Write the Hanson Clock Manufacturing Company, Princeton, Indiana. Their motor is pretty strong and, therefore, capable of carrying the long hands you will require. These units also come in several center-post lengths.

J. E. C.

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Material source

Dear Mr. Coleman:

I have a Mauthe clock that needs a new escape wheel and will have to have it made. Can you tell me who can do it for me?

J. B. HODGES

12 Southeast 35th Street
Oklahoma City 9, Oklahoma

Dear Mr. Hodges:

There is a possibility that Ralph Herman of Ralph Herman Clock House, 628 Coney Island Avenue, Brooklyn 18, New York, may have your Mauthe escape wheel in stock. If he hasn't, he can get your old wheel duplicated.

J. E. C.

Unidentified stone case

Dear Mr. Coleman:

I have a customer who has a French clock with Roman numerals, escape wheel, etc., on front with dial. Round movement, the numerals 45 on the bottom of the back plate. I am sending you a copy of the manufacturer's stamp or brand. The case is unusually heavy and seems to be a manufactured stone; I am also enclosing a very small sample of the case material.

I believe some clock repairman has misled the man, especially in relation to the case, probably having told him the case was solid onyx. Please give me enough information to satisfy the owner. He was told the movement was made in 1823.

L. D. NICHOLS

612 Mesquite
Corpus Christi, Texas

Dear Mr. Nichols:

Movements stamped "S. Marti et Cie, Medaille de Bronze" were made between 1867 and 1889 according to information in our files from R. Marti Etablissements S. Marti, 22 Rue General, Leclerc, Mountbeliard, France. (We believe that you have interpreted the "S" in your stamp as an "L.")

The escapement you refer to as being in front of the dial is the popular Brocot escapement so named for its inventor, Achille Brocot. M. Brocot was born July 20, 1817—thus the owner's date of 1825 makes it when the inventor was about five years old. We aren't very much up on these imported stone cases and your sample was very small. I'd hazard a guess that it is an Italian black marble, and suggest that perhaps there is a marble and granite man convenient to your shop. Have him drop in and have a look-see at the complete case. In the very near future, A. H. & J. will carry a complete article on the Brocot escapement.

J. E. C.

How mystery clock operates

Dear Mr. Coleman:

There is an electric clock on the market now which has no apparent means of driving the hands as they float in the center of the dial, yet it keeps perfect time. I would like to know the secret of this operation. Any information you can give me will be appreciated. Jefferson is the type I have seen.

BRYSON KOEHN

Medford, Oklahoma

Dear Mr. Koehn:

On the particular mystery clock you mention, you will note that the glass is housed within a small metal rim. This rim cuts off your view of outside edge of that glass. Around the glass is a toothed gear which meshes with the electric motor in the clock's base. This glass is driven at one r.p.m. via that gearing. This accounts for the movement of the minute hand.

The hour hand is geared to the minute post through a regular 12-to-1 train arrangement on a weighted arm, gravity holding the arm down so that the revolving of the glass and center-pin through this dial train drives the hour hand one revolution per 12 hours.

J. E. C.

Regulator with sweep second

Dear Mr. Coleman:

In the September issue of A. H. & J. I read with interest Mr. Bennett's and Mr. Gornell's inquiries and your answers on regulation because I am chiefly interested in 60-beat regulators and master clocks. About a week after reading the foregoing, I saw in the home of a retired jeweler a Waterbury No. 65 regulator, 60-beat with

center sweep seconds hand, enameled dial, ornately machine-carved with a mahogany case about 7 feet 6 inches high.

It was weight powered and had a mercury pendulum that seemed to be a later addition. The owner told me his father started in business in Chicago in 1885 and died in 1905 and that the clock was in the store at his father's death. It appeared to be to be of about 1890 vintage.

The seconds hand was lying in the bottom of the case, but he put it on to show it, and this is the only one with center seconds hand I ever saw. I have found many helpful answers to various problems in the American Horologist & Jeweler; Clockwise and Otherwise is always read first by me, and I thought the above might interest you.

JESSE H. WOOTTON
1727 North Sawyer Avenue
Chicago 47, Illinois

Dear Mr. Wootton:

We appreciate your letter on the center or sweep seconds regulator and if convenient would like to have you check this clock a little further. Enclosing an addressed card for your convenience.

It is not firmly established, but we believe this clock may be of foreign manufacture. Look for these features: 1. Is it a pin-wheel escapement? That is, does the escape wheel have some 30 little pins in its rim parallel with the arbor instead of the regular cut teeth? 2. Do both pallets work over to the right (3 o'clock side) just one pin apart? 3. Is the movement enclosed in a black iron box with a door in each side of it and sit on a shelf or bracket against the base of the case? 4. Is there a large brass rim around the porcelain dial, rather thick and heavy?

Should the answers be yes, then I'm pretty certain the movement was French made, that Waterbury cased it and sold same under their "No. 65 Regulator."

J. E. C.

Needs wood wheels

Dear Mr. Coleman:

I have a very fine wooden wheel clock that someone has tampered with and removed some of the parts of the striking mechanism. Since your column in A. H. & J. helps so many out of their troubles, I wonder if you can tell me where I can find someone who understands the mechanism of wooden clock wheels and has wheels, etc.

BEN BUCHTEL
2003 Franklin Place, N.W.
Canton 9, Ohio

Dear Mr. Buchtel:

I suggest that you try Samuel W. Jennings of 500 Dilman Street, Plainfield, Illinois; also that you write him first as to whether he woud like you to ship the whole movement, or just the wheels to be duplicated, etc. His is the closest address we believe we have to Canton.

J. E. C.

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When to Quit Trying to Improve a Watch Beat

Watch Repairman and the OSCILLOSCOPE

By Carl H. Anderson

ONE of the things demonstrated at the Kentucky Watchmakers Association meetings which created a very great interest was how and why you may get an out-of-beat chart when the watch is actually in beat and the reverse condition where the chart shows an in-beat condition when the watch is really out-of-beat. These conditions were easily shown in many of the watches which the boys themselves were wearing. By the use of the oscilloscope the watch repairman knows whether or not the watch in question is actually in or out of beat, regardless of the type of chart the watch prints. It was shown and demonstrated what causes these things and that the cause actually exists in the watch and very definitely is not a fault or condition of any timing machine. Where these faults can or do exist in a watch and how to correct them was thoroughly explained, step by step, and in every possible detail.

Another item in which the interest was equally great was a demonstration of how to know when to leave a watch alone and quit working on it, regardless of the type of chart printed by the watch. It was shown how a watch repairman could spend hours trying to correct a watch from which he had received a bad chart and when he was through he ended up with a no better chart than he had in the beginning. At all of the meetings everyone present said they had had such experiences. It was clearly shown that there is such a thing as knowing when to quit working on a watch or trying to improve it. These are conditions which are present in the watch and nowhere else. Too many watch repairmen have found out all too late that they cannot make the watch in question print a satisfactory chart without completely remaking the entire watch. These conditions are usually always present in the lower grade movements.

Improper watch conditions revealed

■ INSUFFICIENTLY POLISHED fork slots, burrs, rough impulse planes on escape wheel teeth, rough pivots, rough jewel holes, pinions or arbors out of upright, too much pivot slap, binding pivots, set or too weak mainsprings, faulty depthing, improper meshing of wheel teeth and pinion leaves, too much difference between the impulse given the R and L pallet stones, hairsprings off center or out-of-flat and hundreds of other improper conditions cause printing of incorrect charts. However, all of these mechanical conditions as well as hundreds of others are instantly seen and recognized in the trace by the users of oscilloscopes. All who were present at these meetings who are using oscilloscopes testified to the fact they were now satisfactorily repairing trouble-making watches and "come-backs" where formerly they had not. If one were to judge by the statements of oscilloscope users who were present at these meetings, one could not help but leave the meeting convinced that it is utterly impossible to properly repair many watches without the use of an oscilloscope.

Many who were in attendance had all kinds of misconceptions about watches, their repair and various types of charts.

OUR STUDENTS WRITE US—

Dear Friend Andy:

I am enjoying the course and I like your attack, or shall I say approach. I think attack is better because your sayings have such a positive ring. Nothing left for the student to imagine.

How you dissect the maneuverings of the escapement is a revelation. After reading your dissertation one is left with a single thought—"THAT IS IT". You remind me of an instructor I once had. He left the student with one impression, that he not only knew, but, knew that he knew. That is a good thing because it holds the student's interest for the moment, and, for the next thing to happen.

We who are students, and those who are not—yet, will find it difficult to estimate the hours or years of application and concentration with which you were involved—the again and again trying of this or that, because here is something other than what has been considered conclusive, horologically. Fortunate are we, indeed, to get your findings so easily and simply, with so little expenditure.

I receive all, plus more, than one should expect. I understand your words, their meaning, both to the application of the oscilloscope and the watch. But your teachings about the latter, a subject we are familiar with, are so clear even where your explanations refer to the complicated task of explaining two or three things happening simultaneously. In this you succeed.

If one knows the action of a watch he can easily visualize the old teachings and your newer findings. Or, so, it is that way for me. I believe your effort deserves the handshake of every watchmaker and the general public, too. Because you are improving their skill, let there be no doubt that goes for those who remain silent, too. I would like to say it again—let there be no doubt. I am sure of it.

I do not claim any great shakes for myself, but the watchmakers' knowledge is and has been limited, regardless of one's opinion of his own ability. You have revealed so many new findings that it leaves the exalted ones in the shade. That is in reference to only the watch. Now, along with that you introduce the oscilloscope itself, in a sense that we knew nothing of its existence before.

Sincerely,

George W. Ackerman
Founding Member #1

This is but one of the many such letters we have received. We are happy to be able to publish unsolicited letters such as this because they prove the benefits derived from our CORRESPONDENCE COURSE.

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THE INSTITUTE OF HOROLOGICAL OSCILLOGRAPHY

Carl H. Anderson, Founder

P. O. Box 578 · Lexington, Kentucky

Many had the false idea that their charts were being printed from the oscillation of the balance or the difference in time between the tick and the tock. Nothing could be farther from the facts. It was clearly shown and demonstrated that every conceivable fault lay in the watch itself and to secure a correct chart that the watch would have to be corrected. By the use of a marker signal in the trace, it was pointed out exactly which pip (or sound) was printing the chart. Naturally if a certain sound in the tick actuates the printer mechanism and a different sound does likewise in the tock, then it would be impossible to print a satisfactory chart. For all of these demonstrations, watches of those in attendance were used as we positively have never used any "stooges" or "plants" in the audience. Neither do we pass out any specially prepared or "fixed" watches before the meeting to be brought up to the platform for diagnosis. At every meeting several of the boys presented customers' watches which had been giving them trouble. These were diagnosed for all present to see with the aid of the oscilloscope. We have had letters from several in which they stated they found the faults we had enumerated and that the watches were now giving satisfactory service to their customers after they had corrected the faults which we pointed out to them.

We also thoroughly demonstrated the how and why you get both good and bad charts from the same watch. This proved to be a highly interesting subject and brought out many questions, all of which were answered. It happened that several of the boys had watches of their own which gave both good and bad charts. Many were very surprised at the faults the oscilloscope showed in watches which they had repaired only a few days before. Fortunately, none of these watches had as yet been delivered to the customers, thus they were given the opportunity of correcting them before delivery.

Before going further we want to most emphatically state that none of the foregoing can by any stretch of the imagination even be remotely construed as a fault of any timing machine. Absolutely everything we have mentioned is a fault in the watch itself and when the fault is corrected the chart will be satisfactory. You must remember that at all times your chart is being printed from the sounds in the watch, so if the sounds in the watch itself are wrong, your chart will be wrong. Correct the watch and you have automatically at the same time corrected the chart. When you once learn by the use of the oscilloscope to find out what is actually wrong in the watch you will never again "cuss" your charts. Let us repeat—*correct the watch.*

We gave a complete explanation of the resuming and recovery rates of a watch as well as a demonstration of the new

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electronic instrument which shows these rates. There is one particular thing we like about this instrument. It has a built-in loud speaker on which you can turn up the volume until the watch tick can be heard all over the entire store, or it can be turned down to only a whisper, or completely shut off.

Many were interested in the demonstration of how to positively identify the tick from the tock in the oscilloscope trace. This positive identification is necessary at times so you can determine whether the trouble is on the R or the L side. For example, suppose a timing washer is ever so slightly rubbing the top of the pallet bridge. You take out the balance and when you inspect it with your loupe, both of the pair of timing washers look exactly alike. But when you examine your oscilloscope trace you know immediately whether or not it is the washer that is on the roller jewel half of the balance rim or if it is the one which is on the other half of the balance rim. These things may seem trivial or inconsequential, but it is these very small things which waste so much of your time in trying to find them. They show up instantly in an oscilloscope trace.

Magnifying pips

■ THEN WE DEMONSTRATED a watch where the trigger tube (2050 or Thyratron, whichever term you choose to use) fired twice on each tick and each tock. We explained why only one dot was printed on the chart for each tick and each tock in spite of the double firing of the trigger tube. We also showed some slides of this condition. In addition to these slides, we showed many others which were more or less completely diagnosed. By projecting slides of oscillograms on a large screen the pips are enlarged to the point where each individual pip can be pointed out and identified. Also the slide can remain on the screen until a complete examination has been made. This is highly important for those who are not thoroughly familiar with the use of the oscilloscope. Then, too, a pip which appears as only one inch in height on the screen of the oscilloscope can be blown up until it completely crosses a 50-inch screen, or any other size screen for that matter. Such great mag-

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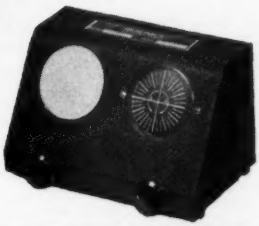

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nification enables the study of many watch conditions which could not otherwise be done.

Everyone was interested in the method of assembling a watch where the balance is put in first instead of last. After an explanation, all agreed that this was by far the best method. Letters are now coming in from those who have adopted this method of assembly, about how much better it is, how much time it is saving them, how it has eliminated many "come-backs," etc. Still another thing in which the interest was high was how to remove plates and bridges without scarring up the plates or leaving burrs. This also included how to remove pallet bridges without breaking pallet arbors. We could go ahead with other points which were covered in these meetings, but the foregoing should tell you whether or not any of these meetings were worth attending. We have already booked several similar meetings for 1955, where these and other developments not as yet mentioned will be fully explained and demonstrated. Those living within 100 miles or so of where a meeting is to be held will receive advance notice by mail of such meetings.

We had the pleasure of demonstrating some new equipment at these meetings. One was an electronic instrument which burns a hole through a tape instead of printing through a ribbon. This instrument has 12 tubes instead of the usual 8. Another was an automatic cleaning machine which cannot set itself on fire because of the use of induction motors and mercury switches. Anyone who has ever had a cleaning machine fire knows what this means.

We plead guilty to devoting considerable space in this article to what took place at our five Kentucky meetings. Since these things were so highly interesting to those who attended the meetings, we felt that possibly they would likewise be interesting to the readers of A. H. & J., or at least we hope so. We sincerely hope we have not bored you.

New 'Time-alyzer' undergoing tests

■ BY THE TIME you are reading this, we expect to be testing another new electronic instrument which contains an oscilloscope and will also show the time rate of a watch. It has been developed by one of the electronic engineers who is responsible for a great deal of the research work and the advancement in the science and art of color television. We understand this instrument will be advertised in A. H. & J. Be on the lookout for it. We have refrained from mentioning this instrument until this time because we did not want anything to appear in print until it was almost time when you could see it yourself. The following is a copy of a letter dated October 25, 1954:

Dear Mr. Anderson:

I have not answered your letter of last April 29 until there was definite news as to when we planned to have a model of our new timer and analyzer available. We now call it our "Time-alyzer" and a production model will be available around the first of December. We would very much like to have you try it out and give us your comments. I am sure you will like several features of the operation, which are as follows:

After the watch is inserted in the holder, the watch rate dial is set to a high number until the tick is seen to go by on the screen. The dial is then adjusted to hold the tick still. This may require switching the slow-fast switch. The watch rate, slow or fast, is then immediately read from the dial. No waiting for a certain period or using any other equipment is necessary. When the watch is very nearly correct, some time may be necessary to make sure that the pattern stands still, and for these adjustments, a vernier dial is provided since the main watch rate dial operates in jumps of about four seconds a day. We plan on a maximum range of about 200 seconds per day, fast or slow, and would appreciate your comments on this feature.

We feel that this watch rate dial will be extremely easy to use. Its accuracy is excellent, especially at zero where it is exactly that of the fundamental standard crystal used. This can be maintained to one part in a million, or better than one second per week. By using a radio receiver tuned to "WWV" for calibration, this accuracy could be increased to a couple of seconds per month without making any connections or adjustments other than the front panel controls.

The "tick" and "tock" are presented separately, one across the top of the screen and the other across the bottom, and the accuracy between the two is exactly that of the scan. Thus the differences between the two waveshapes are immediately apparent and "out of beat" is shown even for portions of a waveshape.

The horizontal scan time is not adjustable and will not be made so unless it seems necessary. Switching or adjusting would be somewhat complicated, but in the production it could be made any desired value. We now have the scan lasting 40 milliseconds which corresponds to a sweep at 25 cycles per second except that the scan is blanked out 4/5 of the time. We have gone to considerable trouble to insure a bright, sharp trace which should produce excellent photographs.

For timing the whole or portions of the escapement, waveshape dots are provided at 3.03 millisecond intervals. Thus 12 timing dots are visible. They always stand still on both the "tick" and "tock" traces.

A three-position switch is supplied for setting the scan frequency corresponding to 5, 5½ and 6-beat watches. No calibration adjustments or other manipulations are necessary for adjusting to these three sweep periods. The rate dial and calibration retain their absolute accuracy for the three watch beats. There are no other front panel adjustments and I believe it should be possible for a watchmaker to operate it satisfactorily without reading any instruction book. Controls such as focus, brightness, centering, etc., should never need adjusting and are either inside or at the back. Their purpose is mainly for factory adjustment.

Considerable emphasis has been placed upon long-time reliability and ease of operation, and the operation is independent of normal line voltage variation.

The case is highly styled and its appearance is such that a jeweler could use it for sales and promotion work on a beautiful counter.

Although we are not completely sure of the price as yet, we have tentatively set it at $395.00.

We would like very much to get together with you for a demonstration and discussion, and would then like to have you run as extended a test as you would like in your laboratory.

Hot ziggety-zowie, diggitie dog! Umum, ain't dat sumthin! If that letter doesn't read like a watch repairman's dream come true, we don't know what would. If these fellows have all they say they have, they really have something. Think of being able to set a watch to an accuracy of one second a week or two seconds a month. Sounds unbelievable, doesn't it? But we happen to know who these fellows are, and also that the chief engineer we mentioned at the beginning of this subject is also a watchmaker, so he not only knows and understands the electronic problems involved, but also those of the watch repairman.

And another thing, who else but A. H. & J. gives you such information? Ever read any similar articles in any other trade publication? We never have. There is one thing you can always depend upon—A. H. & J. is always "the fustest with the mostest." Only in the columns of A. H. & J. can you learn of such revolutionary developments as this.

Simplicity of control

■ THEN YOU HAVE two traces of the screen of the cathode ray tube, one trace being the tick and the other one the tock. Notice it is not claimed that either one is always the tick or the tock, but those who know how to read and diagnose oscilloscope traces can always positively and instantly identify the trace of the tick from that of the tock. Of course the same trace will not always be the same tick or tock. It all depends which is taking place when the watch is placed in the microphone. Whichever one is happening at that exact instant is the trace which will appear first,

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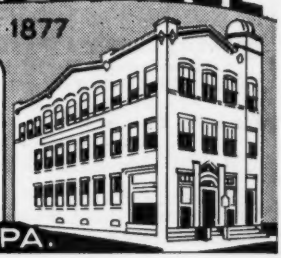

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just the same as it will be the first dot on the tape of a chart. You can instantly see any difference in the action of the escapement during the tick or the tock because one is directly above the other. Also, you can see an out-of-beat condition that could not be seen otherwise.

As for the horizontal scan time not being adjustable, that we like very much. A scan time of 40 milliseconds has been provided, whereas the slowest escapement action time we have ever seen was 35 milliseconds, so the scan could clearly show such an escapement action as the scan is 5 milliseconds longer in duration. You can also see any other escapement action which is less than 40 milliseconds in time duration.

We like those waveshape dots at 3.03 millisecond intervals. One-third of the distance between any two dots would be 1.01 millisecond, thus making it extremely easy to determine exactly how long a time was consumed by any particular action. Then, too, it automatically takes care of 5, 5½ and 6-beat per second watches. No more slanting lines to be read as so many seconds fast or slow, or a chart with two, four, seven, eleven or any other number of rows of dots.

We also like the simplicity of the front panel controls. Present day oscilloscopes have a multiplicity of controls on the front panel as well as a still larger number inside the cabinet. Naturally we like having everything combined into one instrument and placed in one cabinet. After we have had the opportunity of making a thorough check of this new instrument in our research laboratory, we definitely promise an unbiased report. We might add that we have been corresponding intermittently with these people for over a year.

We sincerely wish we were at liberty to tell you of other startling new developments and things in the making which will be of inestimable value to the man at the bench. Not only will he be able to do better work, but do it in much less time. We hope that some day we will be released from all this secrecy and when we are, we will tell you all about it, just the same as we have about the foregoing new electronic combination instrument.

Future Editorial

■ IN PREVIOUS ARTICLES we have mentioned many things we thought would be of interest to the watch repairman. We said we would give full explanations if sufficient interest was shown. For example, we mentioned our charts on "Adjusting," "14-Position Adjusting," "Dynamic Poising," "Centering and/or Leveling a Hairspring Without Removing the Balance Assembly." For these we received a very great number of requests, so they were published, as you already know. There were other things where we received a very limited number of requests and in some instances, none at all. The result was that we did not take the time to write out these items for publication. But we did send the complete details to what few that had asked for them.

Frankly, this department can only occupy a certain part of the space in A. H. & J. We have neither the desire nor the intention of using such space for the pub-

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lication of items where we know there is not sufficient interest. We consider these previous items as a closed matter since all those who asked have long since received the information they wanted. We have therefore decided that for whatever future time we continue to write this department, whenever we mention anything, we will complete it right there and then. That is to say, the original article will contain all we expect to write on the subject. We will write about what we think will interest you without asking your opinion.

We sincerely thank all those who have written us in the past and likewise thank all those who intended to write but procrastinated. In any future articles we may write for A. H. & J., we will not ask anyone to write us. This should clear up any misunderstandings in the readers' minds, should they exist.

There is one thing we would like to make abundantly clear, however. Any reader of A. H. & J., or any other watch repairman for that matter, who really put his mind to it, could have accomplished much more than we have done. Possibly the only difference between us is that we really like to find out "what makes the wheels go around." We sincerely hope we have aroused enough interest or curiosity in some of you that you will take up from here and carry on with much better research work and findings than we have been able to do. We will gladly concede to anyone who is interested.

"All we ever find are these lousy stones—not a brontosaurus tooth for miles around!"

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"Bench Practices for Watch Repairers"

Henry Fried's Latest Book

Review by DR. ARTHUR L. RAWLINGS

One of the most difficult forms of writing must surely be that in which the author attempts by the written word aided by pictorial illustration to teach the uninitiated an art involving some bodily skill or manual dexterity.

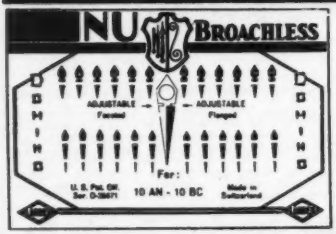
There are many books purporting to give instruction in watch repairing and Mr. Fried gives an admirable list of these, often with references to particular pages; but none of them, so far as I know, covers the ground in anything like so much detail as he does in his "Bench Practices for Watch Repairs." He devotes about 60 pages and 86 figures to the section on "Complete Hairspring Practices"; while Kleinlein has 45 pages and 20 figures and Garrare (whose book was my first introduction to the art) uses only 15 pages and 14 figures to cover the whole process of choosing and fitting a new hairspring, vibrating, raising an overcoil and timing in positions!

Mr. Fried not only has an inborn aptitude for teaching but his many years experience as an instructor have taught him just where the learner will find difficulties. In writing his book he seems to have asked himself after every sentence, "Now what questions will the student be likely to ask?" and has added an explanatory diagram, or a few extra words to clear up any doubts that can arise. The consequence is that we have here the most thorough and complete book on the subject that has ever been published in which every foreseeable difficulty has been anticipated.

The illustrations, all drawn by the author, showing manipulative positions, tools and equipment are beyond praise. Often, more than one method of doing a job is presented so that the watchmaker can choose the particular one most suited to his individual aptitude and style of working.

A considerable section is devoted to various devices to aid in the operation of vibrating a hairspring, and this may lead one to wonder whether the average watch repairer really needs such help. A specialist in vibrating, whether in a factory or working on his own account will naturally want all the time-saving equipment he can get and will be using it continually. The case of the average watch

The ONLY ADJUSTABLE FACETED HANDS



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jobber is quite different; he may only have to fit and vibrate a new hairspring once or twice a month, and the cost of a vibrating machine would not be justified. A watchmaker who would fit a new pallet stone as a regular thing often doubts his own ability to do the much easier operation of vibrating a hairspring with no other equipment than a pair of tweezers and a watch with a second hand. So he sends the job out, pays a pretty stiff price for the work, and has to wait several days for it to come back. Mr. Fried's book briefly describes the operation of hand vibrating, but it is suggested his next edition should treat this subject much more fully.

Vibrating by hand

THE OLD WATCH JOBBER faced with a ruined hairspring used to choose from his stock a new one about the right size, fix it to the balance temporarily under the old collet, grip one of the outer coils with the tweezers, twiddle them with the fingers to start the balance vibrating with its pivot resting on a watch glass, and count double vibrations for 20 seconds. If it made about 50 oscillations the spring was right for an 18,000 train. If it was wrong, he tried again with a thicker or thinner spring; if right, he pinned it to the collet, trued it in the round and flat (the longest part of the job) and vibrated as before but for a full minute to find the point for the curb pins and so for the stud. With a little practice the whole job was done in about a quarter of an hour. When the spring was set going in the watch it would seldom be exactly to time, but would have to be let out or taken up a little at the stud. However, it is seldom that a machine vibrated spring runs exactly to time with the regulator in the middle, so the spring may have to be repinned at the stud in any case and there is no advantage on this score.

The art of vibrating by hand is easy to learn, and if Mr. Fried would deal with it more fully, with drawings in his own inimitable manner he would be adding still more to the debt the watch repairer already owes to him.

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Jewelry Repairing

By R. ALLEN HARDY

Mr. Hardy invites your questions pertaining to jewelry repairing. Questions should be directed to Mr. Hardy, c/o The American Horologist & Jeweler, Box 7127, Capitol Hill Station, Denver 6, Colorado. Please enclose a self-addressed, stamped envelope.

Hard Soldering on Silver

DURING my recent travels, I have been asked many questions pertaining to the repair of jewelry and although many questions fall into the general category, occasionally there comes a very interesting query, one that I cannot answer without sitting down and surveying the situation.

One that I will illustrate is a knife charm that came into a shop, not for repair but to affix an emblem securely to its surface. The jeweler was going to do a simple job of soft soldering (even though he wasn't happy with the idea). I was convinced soft soldering on such an article would hardly be a secure way of anchoring the emblem since a certain amount of abuse could be expected.

We found the knife to be constructed of the usual steel parts but the outer plates were of sterling silver. At first glance, we could not see how the plates were attached but on closer examination discovered small rivet heads, cleverly camouflaged. Our answer was already mapped out for us—drive out the rivets, remove the plates, hard solder the emblem to a silver plate, restore plates to their original position using new rivets.

Methods of Working Up Beads and Milgraining in the Setting of Small Stones

■ THERE HAVE BEEN so many inquiries about stone setting and requests to go into it again that there seems to be no way out. This time, however, we will approach the subject from a different angle although the basic principles will be the same as already discussed in The American Horologist and Jeweler—July, August and September issues, 1954.

First, let us examine *Figure 60* (Page 60) which shows a lady's wedding band, set with five small diamonds.

This style of setting is the simple flat-top style used frequently for mounting men's large solitaires. Mounting the five stones requires a knack of close estimation, for the stones have to be spaced, if not equally, then at least in a manner pleasing to the eye. It is not always possible to space stones equally because the diameters at the girdle are almost never exactly the same.

It would be most wise to place the largest stone in the center, the next larger two beside it, and the two smaller stones on the ends.

The mounting usually comes to the jeweler looking like *Figure 61*. It is up to him to carefully measure the five stones and decide then and there if they will work in the given mounting.

Assuming that they will work, cautious-

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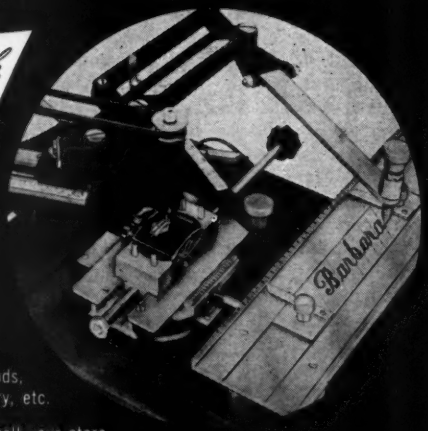

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ly proceed to burr out the openings designated for each stone. (This is done by selecting a burr slightly smaller in diameter than the stone to be mounted—as the burrs make openings slightly larger than their diameters.) Using the flexible shaft machine, this operation is completed in seconds.

Rather than complete the mounting of one stone at a time, it is best to anchor all five in their respective positions. This will allow for freedom in "trimming up" and "finishing off" the setting job.

This anchoring is done by "working up" four beads to hold each stone. Each bead is in a square or corner position. See *Figure 62e.*

Figure 62 illustrates the progressive steps of setting a small diamond or melee from the burring out of the seat (a) through the final trimming-up (e).

In a previous issue, when "working up" a bead was explained in detail, we were discussing the mounting of a larger stone. It was necessary to weaken the sides of the bead before pushing it over the stone. In setting small stones, such as we are now discussing, this is not always necessary since the size of the bead is comparatively much smaller and may be very simply pushed over with a small round-belly graver. See *Figure 63.* This graver should be about size 50 or 51.

To "work up" this bead, simply place the graver in position (see *Figure 64*) and wiggle it from side to side as the rear section or handle is gradually lifted upward. This movement "throws" a small burr (later it is a bead) against the stone. Needless to say, the procedure is to anchor opposite corners respectively in order to obtain a level table. One very good word of caution—a bead is not made by digging into the metal with pressure forward, toward the girdle of the stone. Contrary to the beginner's usual idea, the pressure at the tip is downward and away from the girdle. If this idea is followed, there is little danger of slipping forward and cutting off the bead completely. The shape of the face of the graver (if about 55°) will be a wedge that forces the bead forward as the tip works itself deeper. It is not the particular effort of the stonesetter that gets the bead over the girdle; it is the wedge-shaped graver that does the work as it bites deeper into the metal.

Fig. 60

Fig. 61

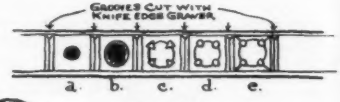

Fig. 62

Fig. 63

Fig. 64

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When each stone is snug in its seat, each burr may be slightly rounded into a bead by using one of the beading tools. This will establish a uniform size for all the beads and will isolate bits of metal that will be trimmed away later.

At this stage, study the distance between each stone to determine whether there is need for a double or single row of milgraining. If the area seems to call for a double or single row of milgraining then, using a knife-edge graver, *Figure 65,* make a single cut midway between each stone. See *Figure 62.* Later, when the individual settings are trimmed, this groove will help furnish a knife-edge ridge over which the final milgrain tool will travel.

Now it is time to select a flat graver of a width suitable to small settings. A No. 36 or No. 38 will do very well. Trim away all excess metal around the girdle of each stone as shown in *Figure 66,* remembering that a highly polished graver leaves a highly polished surface. Be especially careful while cutting close to the sharp edges needed for the milgrain tool —these must be carefully preserved.

Before using the milgrain tool for the final step, carefully check the firmness of each stone and the roundness of each bead. If they need touching up, now is the time to do it.

Very carefully milgrain all prepared edges and the job is complete.

* * *

The five stones just discussed, set in five individual flat top settings, might very easily (and more quickly) have been set in

Fig. 65

Fig. 66

Fig. 67

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a more modern channel mounting. Usually stones to be set in channel mountings are of a nearly equal diameter since the finished job must be neat and regular, and without the bulge that an outsize stone would make. See *Figure 67*.

This type of mounting is particularly adaptable to the setting of many very small diamonds. (Sometimes diamonds are set in this manner, running completely around the band, with no break or plain gold band showing—or platinum, as the case may be.) These are placed in a channel, girdles resting on a race or ledge already prepared for such stones. They are placed side by side, girdles barely touching. The two top edges of the channel are burnished over the stones in long sweeping strokes with a highly polished steel burnisher. While some edges may be left plain, depending on the design of the mounting, most of this style are milgrained to further insure the tightness of the stones and to add to the beauty of the design.

Some channel mountings may have single holes drilled for a specific number of stones. In this case the stones must be of very exact measurement. To insure their stability, slight seats are burred out and the only other concern is to see that all remain level as the channel edge is burnished or milgrained over the girdle of each stone. Here, again, dimensions must be fairly exact for to insure the desired beauty of setting, the girdles of each stone must be side by side.

Soldering outfit

Dear Mr. Hardy:

Am enjoying your articles and would be among the first to buy them if in book form. As I am buying an electric soldering outfit, will you advise me of the best obtainable? My shop is a one-man shop doing ordinary repairs. As I am requesting a material and tool catalog from the Florida Supply, will you accept my thanks for this information.

R. SAFFER

27 Helena St.
Rochester 5, N. Y.

Dear Mr. Saffer:

I am glad to know you like my articles and you may be glad to know that a book I have written on the subject is in the hands of the publishers now. When it is released you may receive your copy by placing an order with the American Horologist & Jeweler.

Your request for advice on the best soldering machine obtainable is a hard one to answer since there are many very excellent machines available. However, I can recommend the one with which I am most familiar. It is the Little Giant soldering machine put out by the C. & E. Marshall Co. This machine is very sturdy, compact and has the desirable feature of a dial rheostat.

Concerning material and tool catalogs, let me suggest you contact Tela-Time, a C. & E. Marshall distributor located in New York City. They will be very glad to take care of you, I am sure.

R. A. H.

Engraving book

Dear Mr. Hardy:

Kindly inform me as to where I can obtain a good book in learning to design monograms and letters for engraving. I have a few but they are not exactly what I am looking for.

Or, better yet, is there an engraving school which may have booklets or possibly a correspondence course. Thank you.

EDWARD J. LUCAS

191 Seaside Ave.
Stamford, Conn.

Dear Mr. Lucas:

There is a book entitled, "The Jewelry Engravers Manual," just recently offered for sale. Its co-authors are R. Allen Hardy (myself) and John J. Bowman (director of Bowman Technical School). I believe you will find this book will give you exactly the information you request, in as much as it is based on the engraving course offered by Bowman Technical School. It takes you step by step from the funda-

mental phases of designing monograms and letters through the intricate phases (as well as cutting instruction). In compiling this book we realized that one illustration is worth a thousand words, so the emphasis is there.

You may obtain this book by placing your order now with the American Horologist & Jeweler.

Yours very truly,
R. A. H.

Use of block in setting

Dear Mr. Hardy:

I am a reader of your articles in The American Horologist & Jeweler, and am very much interested. So far in your writing, I haven't noticed where you mentioned anything about "Channel Settings" or how to set an "Emerald Cut Diamond." Would it be a good idea to use an engraving block to hold a mounting when setting stones? How would you go about getting scratches off an onyx stone and restore the beautiful finish?

Yours truly,
JOHN NAGY
5035 First St., Versailles
McKeesport, Pa.

Dear Mr. Nagy:

Your interest in my articles is greatly appreciated. Concerning your references to diamond setting, you will find a discussion on "channel settings" in this issue. I intend to continue with stone setting since there is so much interest shown in that field. Setting "Emerald Cut Diamonds" will follow shortly.

I can see no reason why you should not use an engraving block to hold mountings when setting stones, provided they are held firmly—with no possibility of slipping or marring the metal. Some of my students in stone setting found that they could get better results by using the engraving block and, although I preferred the ring clamp with its leather jaws, I found that the engraving block offered a definite advantage on some setting jobs.

As I am not a lapidary, I do not feel qualified to advise you on your last question.

R. A. H.

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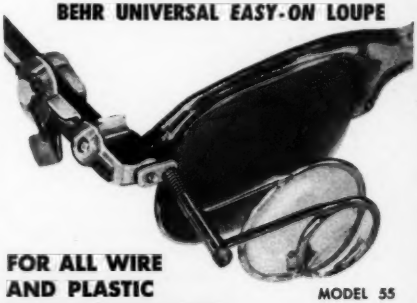

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Watch Faces Reflect Changing Times

Tastes in Watch Designs Are Becoming More Uniform

SWISS WATCHMAKERS used to be able to tell a person's nationality merely by looking at his watch. Now they are not so sure.

A recent Swiss survey reveals that tastes in watch designs are becoming more and more uniform; that national characteristics are becoming progressively less discernible in the type of watch most popular in each country. Among the reasons for this increasing uniformity of taste are films, radio, rapid transportation, and modern merchandising methods. But although certain trends in popular demand are universal (for instance, eight out of ten wrist watches sold today are in round cases instead of the rectangular cases most in demand 20 years ago), local factors still have an influence. Even genetics have a bearing on watch design. For example, the usually small-boned Orientals prefer very small wrist watches, while certain northern Europeans like large pocket watches. An interesting exception is found in Siam where there is a great demand for outsize wrist watches with very fancy dials.

Chinese liked two

Before the first World War, enterprising Shanghai merchants did a thriving business, especially in the inland provinces, by selling watches in pairs. This was because cultured Chinese adhered to the ancient Yang and Yin concept which holds that as man is counterbalanced by woman, so everything must have its opposite to be complete.

The Swiss made pocket watches for China which wound with a key because Chinese men liked to wear the key around their necks to signify that they owned a watch.

Islam nixes pig straps

Watch tastes in the India and Pakistan of today reflect the modern influences at work among peoples who have recently gained independence. Unlike the richly ornamented timepieces that once were the vogue, the emphasis is now on the practical type of watch. By far the most popular are watches in round stainless steel cases which protect the movement against dust and moisture better than other shapes, and more expensive metals. The men prefer these utility and economy-priced watches with black numerals on plain white enamel dials. The women like them as tiny as possible.

Since the Mohammedan world regards the pig as profane and some sects hold the cow to be sacred, the Swiss hardly ever ship watches with leather straps into the Middle East. Some go with metal or plastic wristbands but mostly with none at all.

About the only exception to the declining popularity of the rectangular watch case is in South America where there is still a demand for men's square and ob-

long-shaped wrist watches on the Pacific side of the continent—Chile, Peru, Colombia.

North American watch tastes, the Swiss say, adhere to no set pattern. There is increasing demand among women for tasteful novelty designs and jewelry-timepieces. Canadian and American men are turning to watches with calendar attachments and automatic movements. These automatic self-winders are regarded as the outstanding modern contribution to the ancient art of watchmaking.

Variance 'down under'

Watch tastes in Australia are also variable, the survey showed. Melbourne jewelers find their customers prefer more conservative and expensive watches, while tastes in Sydney more nearly approximate those of the United States. So do those in the Philippines. As might be expected, watch tastes in South Africa are similar to the conservative tastes of the British Isles.

Generally speaking, the Scandinavian peoples keep abreast of the more quiet modern watch stylings. Sweden has passed a law prohibiting gold watch imports which will have a definite effect on watch sales. West Germans select watches with modernistic designs and dials. Especially they seem to like yellow gold cases with applied gold numerals on the face.

Wrist watches styled for women are only now beginning to become popular in Italy. Many Italian women wear the smaller sized men's watches. Italians in general do not like tiny timepieces and the men usually purchase large round watches with elegant **cases and dials.**

What do Swiss wear?

And what of the Swiss who produce watches? Although reliable statistics are not available, it is commonly held that the Swiss own more watches per person than any other nation. They have no set tastes, and many a master watchmaker's proudest possession is the timepiece that he himself designed and executed as a student—a watch made from a bar of brass with tools he also made himself.

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50% Deposit with Order FOB Memphis

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WMDA Begins Work On Catalogue

■ THE KEY to the solution of the watchmaker's material-fitting problems was created early last month when the Watch Material Distributors Association of America took a decisive step toward the building of its long-heralded "universal catalogue." The Association signed a two-year contract with Henry B. Fried, horological author and teacher, to prepare the catalogue. The project is expected to result in the most authoritative and complete source of parts interchangeability information for watchmakers.

Shown in the photo above at the time of the signing of the agreement in the Association's headquarters in Washington, D. C., are, from left to right, WMDAA's Executive Director Stanley G. House, President Gene Sobel, Technical Advisor Henry Fried, and Gene Swigart, former WMDAA president who assisted in drafting the catalogue contract.

Elgin Expands Valentine Promotion

■ ELGIN NATIONAL Watch Company is expanding plans for its nation-wide Valentine promotion this year to give jewelers as much help as possible in the post-Christmas sales period.

A. L. Rowe, vice president in charge of marketing, says Elgin decided to enlarge the promotion in view of last year's success.

A new motion display for jewelers' windows has been designed by Elgin as the focal point in the drive. The display will be tied in with the "Elgin Hour" at an appropriate time, and television viewers will be reminded to give an Elgin watch as a Valentine gift.

The motion display and supporting trim, along with newspaper mats, will be furnished free to jewelers who purchase eight watches. Retail prices on the eight watches run from $33.75 to $71.50 giving jewelers an attractive assortment of popular price ranges.

The entire Valentine package contains four new ladies' watches, four men's watches and a 13-piece promotion kit that includes the window display.

Designed as an eye-catcher, cupid bounces up and down over a large heart-shaped Valentine with a bow and quiver. Copy on the display reads, "Aim for her heart with an Elgin watch."

E430 4½ 13 10½"
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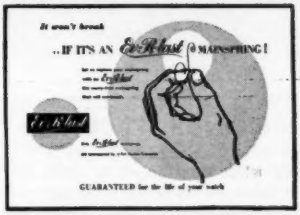
Ev-R-last
MAINSPRING
GUARANTEED
for the life of your watch
GUARANTEE
This mainspring is guaranteed to be of highest quality and will be replaced free of charge if it breaks under normal conditions.

BUILD YOUR BUSINESS 3 WAYS with *Ev-R-last* THE QUALITY MAINSPRING

1. **ATTRACT NEW CUSTOMERS** into your store, by the counter display card and newspaper mat about this new worry-free mainspring.
2. **BUILD CONFIDENCE;** your satisfied repair customers will buy in your other departments and recommend you to others.
3. **INCREASE YOUR REPAIR PROFITS,** because you can charge more for Ev-R-last, the guaranteed mainspring. Show the printed guarantee on every Ev-R-last envelope.

Yes, smart jewelers everywhere are telling us success stories about Ev-R-last, how they have increased store traffic and repair profits by selling Ev-R-last. The Ev-R-last guarantee inspires confidence, and Ev-R-last lives up to it. Because Ev-R-last is made of a new alloy steel, its life is equal to or longer than any other part of a watch. It keeps its resiliency, is rust-resistant, and comes in 75 of the popular sizes. Yet Ev-R-last costs you only $3.00 per dozen.

Be sure you know about Ev-R-last and the prestige and profits it will bring to your store.



TO HELP YOU SELL — Use this attractive 2-color display card in your window, on your counter; it atracts customers into your store. Write for a free newspaper mat (3" x 2 columns) for your local advertising.

Write your material supply house for an Ev-R-last circular today.

HAMMEL, RIGLANDER & CO., INC. NEW YORK 16, N. Y.

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5 Minute Quiz for Watchmakers

1. Do you know the 12 correct steps in disassembling a watch?
2. Do you know the accepted 39-watch assembling and watch inspection steps?
3. Can you identify any watch movement mark, foreign and domestic?
4. Do you know the standard system for ordering watch parts?
5. Do you know the firm names, addresses and phone numbers of hundreds of watch supply houses?

If you **CANNOT** answer all of the above questions, we suggest you order your 1955 copy of the JEWELERS' BUYERS GUIDE—**ONLY $3—10% DISCOUNT FOR CASH.**

If you **CAN** answer all of the above questions, **CONGRATULATIONS! !**

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Incabloc Supplies Retail Kits

■ IN ONE of the most unusual advertising campaigns ever created in the watch industry, Incabloc Shock Absorbers is supplying complete retail merchandising kits to jewelers throughout the United States, as well as the entire Western Hemisphere. This merchandising campaign, the largest in Incabloc's history, is part of Incabloc's program to increase watch sales. It was announced by William Wenzel, vice president and sales and advertising manager of the Incabloc Corporation, 15 West 46th St., New York 36, N. Y.

The sales promotion material sent to more than 10,000 leading jewelers throughout the United States will identify the retailers with Incabloc's current advertising campaign, as well as provide jewelers with watch selling tools and sales aids. The current series of Incabloc ads appear in such magazines as Life, Look, Saturday Evening Post, Collier's, Time, Ebony, Farm Journal, Woman's Day, and The New York Times Magazine.

Leading jewelers throughout Latin America are also receiving Incabloc kits. Both the U. S. and Latin American campaigns were prepared under the direction of Wenzel and Julius S. Impellizzeri, president of Incabloc, in conjunction with the Gramercy Advertising Co.

L & R Co. Expands Production

■ MAX A. LAZARUS, president of L & R Manufacturing Co., is pictured looking over the new specially constructed chemical blending tanks, before installation alongside the company plant in Arlington, New Jersey.

The additional 4,000-gallon capacity blending tanks will enable L & R to increase its production for the manufacture of chemicals for the watch and jewelry industry. L & R manufactures watch cleaning and rinsing solutions, jewelry cleaner and silver polish, crystal cement, rust remover and solderzit.

These L & R chemicals, as well as watch cleaning machines, may be purchased from watch material distributors throughout the country. Complete catalog is available from the L & R Manufacturing Co., 577 Elm St., Arlington, N. J.

Product Catalog by Levin

■ A NEW CATALOG containing the complete line of products available to the trade has recently been published by Louis Levin & Son, Inc., 3610 South Broadway, Los Angeles 7, California.

The catalog, known as "Catalog M," pictures and illustrates precision lathes, micro-drill presses, micro-drills, watchmakers' tools, and various attachments.

Information regarding the catalog should be sent directly to the firm.

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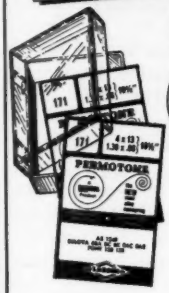

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Sinkler Elected AWMA Head

■ ARTHUR B. SINKLER, president of Hamilton Watch Co., Lancaster, Pa., was elected president of the American Watch Manufacturers Association, effective January 1, 1955.

Sinkler succeeds J. G. Shennan, president of Elgin National Watch Co., Elgin, Ill.

Membership of the association includes Hamilton, Elgin and the Waltham Watch Company, Waltham, Mass., the three domestic jeweled watch manufacturers whose production facilities are located in this country.

Adjustable Hand Line by Larsen

■ AN ADDITION to the NuBroachless line of watch hands is the new Domino Adjustable-Faceted hand, announced by the Larsen Importing Co., New York City.

The NuBroachless line consists of hundreds of different combinations of all types of watch hands, as well as the full range of metric sizes, with the addition of new styles, sizes, and colors.

The new Domino Adjustable-Faceted hands represent a much-needed technical improvement in this type of hand, according to the Larsen firm. Faceted (or pitched) hands are much in demand for their distinctive, full-bodied appearance, and to the watchmaking technician they have always presented a problem because of the difficulty of adjusting them for proper function, the company states. This difficulty consisted of the fact that the process of leveling these hands has a tendency to stretch the socket, thereby impairing its grip on the hour wheel or pinion.

A new invention incorporated into the Domino Adjustable-Faceted hands is said to eliminate this, making possible to bend the hand up or down, right or left, without affecting the socket. An application is now pending in the U. S. Patent Office for a patent on this invention.

Distributed by wholesalers throughout the United States and Canada, the hands are put up on cards for all popular models.

J-B Brings Out Two New Bands

■ JACOBY-BENDER, INC., manufacturers of J-B Watch Bands, recently announced the introduction of two new full expansion watch bands for men into which has been incorporated the new J-B Multi-Size feature. The two new bands are stainless steel throughout.

One band, identified by the name "Edgeford," retails at $5.95 and the other band, "Diamond Champion," retails at $5.50. Both bands are available with ⅝" or ¾" ends.

Max Jacoby, president of the company, reports that the yellow gold-filled expansion bands, which already include the Multi-Size feature, have proven to be the biggest selling models ever introduced by his company. He explains this is due to the convenience of being able to custom-size these bands to fit any man's wrist. No tools are required, with no fussing. Multi-Size bands can be lengthened or shortened in a few seconds.

The two new stainless steel Multi-Size bands are available individually carded on J-B velvet display cards or they can be purchased in assortments of six. These

USED WATCHES!

Wrist	7J—$2.00	17J—$3.00
Pocket	7J—$4.00	17J—$5.00

Pocket watches have original cases. Some of these watches may need minor repair. All are sold on a money back guarantee!

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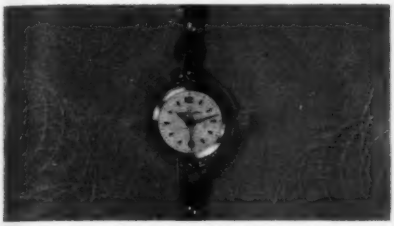
SOUTHERN WATCH COMPANY **Gray 2, Georgia**

assortments come in wallet-size folder tray that includes three of each model. The folder-tray is supplied free when six bands are ordered this way, and are available through authorized wholesalers.

New Eterna Ladies' Water-Resistant



■ ETERNA WATCH COMPANY has released what is claimed to be the world's smallest water-resistant, self-winding lady's Eterna-Matic watch, with direct sweep second hand and ballbearing-mounted automatic winder. In 14 karat gold-filled, it is available in either strap or cord model, and retails at $95.00 f.t.i.

Ike's Alarm Buzzes at Wrong Moment

■ DURING a recent press conference, President Eisenhower's Swiss alarm wrist watch, set to remind him to attend the conference, started buzzing two minutes after the meeting had begun. One New York newspaper noted: "The news that the Man in the White House uses an alarm wrist watch must be a comfort to thousands of other Americans . . . Development of the alarm wrist watch is one of the brightest spots in the whole history of time recorders. It represents a marriage of two devices, the alarm and the watch, both of them creations of horology's golden age . . . More than 50,000 alarm wrist watches have been bought in the United States since they were first offered for sale here in 1947 . . . Occasionally the watches go off at odd times—during the sermon at church, at a tense moment in a movie thriller, on a quiet afternoon in the public library. For the most part, though, they help keep busy America on time."

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Inquire about special bargain prices on items only of interest to you.
Staff for all Calibers (perfect pivots) **$1.00** dozen. Stems, **60c** doz. Mainsprings, **$1.65** doz. Unbreakable Mainsprings, **$3.75** doz. H & M Hands with Sockets (blue or gilt) **$1.25** doz., pair on cards.
Write for latest complete free catalogue of famous RONDA STAFFS AND STEMS.
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Micro-Drilling

THE drilling of small precise holes is an operation which is becoming more and more commonplace in shops doing fine instrument work. The sizes of the holes are also constantly decreasing.

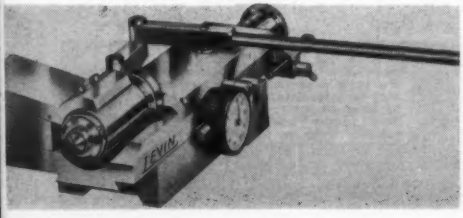
The general principles of drilling apply equally to large and small holes. However, there are differences in technique. In the case of large holes, it is a comparatively simple matter to make a proper center and follow it up with a drill of the required length. If the hole is large enough and of sufficient depth a drill with oil holes may be used to introduce sufficient coolant at the proper place.

In micro-drilling the same conditions do not exist. By micro-drilling we mean drilling holes in the range beyond a number 60 drill. In this area even making a proper center to start a drill becomes a problem. For there are no ready-made center drills available for such work. If the hole is relatively deep and of very small diameter, it is almost impossible to get coolant into the hole and, except at the start, for all practical purposes the drilling is done dry.

Closer tolerance

The tolerances, both as to diameter as well as runout, must be held closer than in the case of large drills. Furthermore, when drilling very small in tough materials one is limited by the actual strength of the drill itself. It frequently happens that a drill will not stand the pressure

Figure 1—Revolving spindle drilling attachment for Micro-Drills.



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Sent with every $25.00 order. Cases are our selection, yellow, and in various sizes.
5 American Pocket Watches..... $22.00
10 Swiss High-Grade Wristwatches..... 15.00
5 American Wristwatches: Elgin, Waltham, etc..... 15.00
20 Watch Movements sent for 1 pound of any G. F. Scrap you send us.
Above need minor repairs. Write for price list.
B. LOWE, Holland Building, St. Louis 1, Mo.

required to cut through the metal and in such a case, the drill simply buckles and snaps off.

In the conventional methods of drilling the operator applies pressure directly to the drill in accordance with rate of cutting. Thus the work is dependent upon the operator's sense of feel.

The drilling apparatus shown in *Fig. 1* was developed primarily for micro-drilling operations. It has been successfully used for drilling holes as small as .0016" and it does not require any unusual skill on the part of the operator. As another example of work done with it, a .023" hole was drilled through a piece of drill rod 1.062" long and the total indicator run-out was less than .0002".

Hole started with drill

When using drills which are only a few thousandths of an inch in diameter it is, of course, impractical to use a drill jig bushing or a centering tool. It is, therefore, necessary to start the hole directly with the drill. It is at once apparent that the surface of the work must be smooth enough so that the drill point will not be deflected by tool marks, and that the drill must be absolutely centered with the work. In the case of a drill as small as the one mentioned above (.0016") even a misalignment of only .0001" becomes serious.

Referring to *Fig. 1*, the reader will note that the spindle of the drilling attachment is mounted on a pair of adjustable slides. By means of the slides it is possible to quickly center the spindle on any lathe on which the attachment may be used.

The centering is done as follows: In both the lathe head and the drilling spindle there is placed a small rod with a pivot measuring .004". The two pivots are brought end to end and the slides are adjusted until under a strong glass the two pivots form a single hair line. This can be done in less than a minute with extreme accuracy.

When the operator applies pressure to the handle on the slide, the slide is kept against a stop screw. The stop screw has a graduated dial which controls its movement. Thus the slide cannot advance any faster than the dial is turned by the oper-

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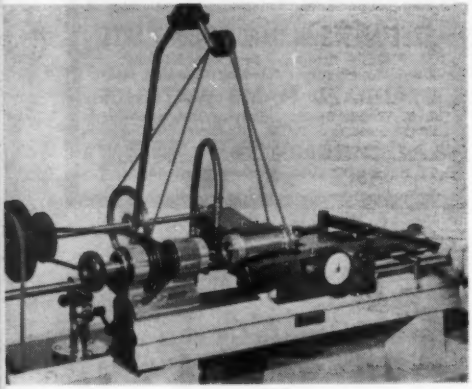

Micro-Drilling on Jeweler's lathe.

ator. If the slide is retracted to clear the chips from the drill, it can be returned to the exact position where the drill ceased cutting without the danger of having the drill strike the bottom of the hole. The setting of the stop screw determines the depth of which the drill can be returned.

A second adjustable stop screw is provided to control the final depth of the hole. The dial indicator enables the operator to watch the progress of the drilling. It may also be used to indicate the point at which the drill first contacts the work.

Pivot drills advisable

Since so much of the work done with the drilling attachment is done without centering, it is advisable to use the so-called "pivot drills" or watchmakers' drills. This type of drill has an oversize shank and is exceptionally rigid for its size. When the depth of the hole exceeds the length of the flutes of a pivot drill, it is used only for starting the hole. The hole is then finished with a regular twist drill. Of course, if the hole is smaller than the smallest commercially available twist drill, then there is no recourse but to use a pivot drill and the depth is limited by the length of the flutes.

Bulletin N, giving a complete description of the drilling attachment and micro-drills, may be obtained by writing to Louis Levin & Son, Inc., 3610 South Broadway, Los Angeles 7, California.

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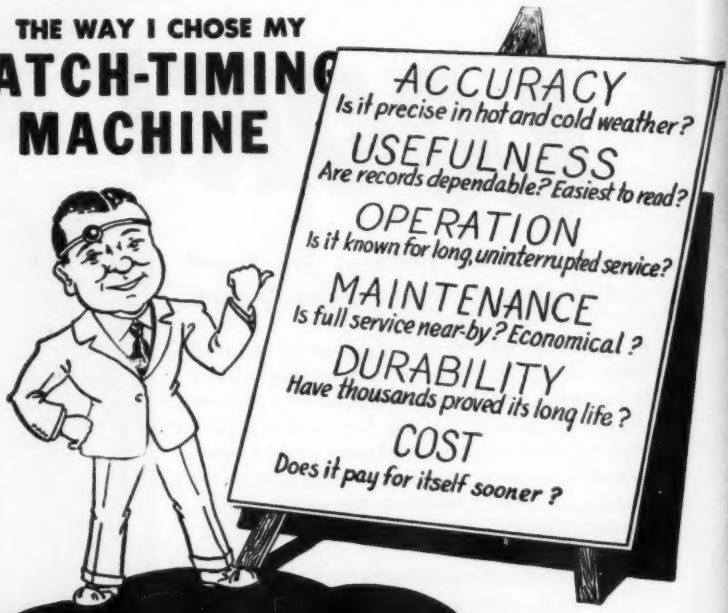

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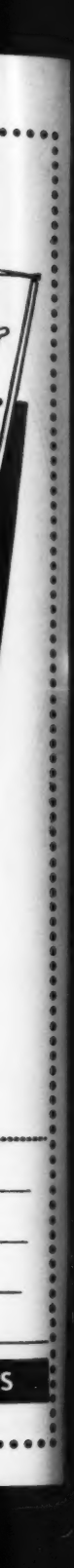
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